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The perennial Cape Cod Canal scheme comes up again as the Bass River Canal Co., the name of the last company organized, and asking for a charter. Some very good names, however, are mentioned in connection with the new project, including that of Prof. Elihu Thomson, who, it is claimed, is to provide an electric towing and lighting plant for the canal.

Bids for a new water supply conduit at Rochester, N. Y., are to be opened on Dec. 23, as stated in detail in our advertising columns. The first section, about 12,000 ft. in length, will be of masonry, 6 to 6½ ft. high, width not stated, partly in open excavation and partly in tunnel. The remaining 140,000 ft. will be of riveted steel pipe or of cast iron, according to the proposals received. Bids are wanted on 38 or 40-in. riveted steel pipe and on 36-in. cast iron pipe of three different thicknesses, both for furnishing and laying, the bids for laying to be on two different routes. The conduit will begin at the northeast corner of Hemlock Lake and end at the Mount Hope reservoir, in Rochester. It will be about 29 miles long. Mr. Geo. W. Aldridge is President of the Executive Board.

The proposed New York & New Jersey bridge, across the Hudson River, is strongly opposed by the New York city authorities. The company is trying to get a bill passed by Congress permitting it to construct the bridge, and the Sinking Fund Commissioners have made formal protest against its passage.

A company with $1,000,000 capital has been formed at Bridgeport, Conn., to construct a dam across the Housatonic River, between Oxford and Monroe or Newtown, for the purpose of creating water-power, to be used in the generation of electricity for power purposes at long distances. The dam will be not less than 30 ft. high. The plan is modeled after the plant in operation in Frankfort, Germany, which has been in operation for ten years, and where, it is said, that the power is transported 80 miles with a low percentage of loss. The application for a charter will be presented to the next legislature by Robert S. Hinman, of Oxford, Conn.

The Brooklyn Bridge, for the year ending Dec. 1, 1892, carried 41,672,898 passengers on the cars, and received $1,144,996 for railway tolls, $83,733 for carriage tolls, $87,824 for warehouse rents, and $17,709 for rent for telegraph wires on bridge. The receipts from all sources, including $300,000 from Brooklyn, and $150,000 from New York, on construction account, and balance on hand were $2,154,842. The total expenditures were $1,715,531. Since the opening of the bridge, on Sept. 24, 1883, 262,200,181 passengers have been carried. During the Columbus festival week, Oct. 8 to Oct. 15, 4,033,920 passengers were carried on the railway, an average of 130,126 per day. On Oct. 12, 223,625 passengers were carried, the greatest number in any similar period. To accomplish this, on Oct. 12 and 13, the cable was run for 44 consecutive hours, with trains of 2 to 4 cars (averaging 3½ cars), on an average headway of 2 1-15 minutes. During 24 hours on Oct. 12, 770 trains were hauled on an average headway of 1 5-6 minutes.

A fast run on the Chicago & Alton R. R. is reported as having been made on Dec. 2, between Chicago and Springfield, Ill. The run of 186 miles, to a point one mile beyond Springfield, was made in 196 minutes, with 14 stops and 8 times slacking speed. The average running speed was about 57 miles per hour. The train was made up of seven cars, and was hauled by an eight-wheel engine with cylinders 18 x 24 ins., driving wheels 5 ft. 3½ ins. diameter, and weighing 93,000 lbs. The same engine is said to have run 127 miles in 137 minutes, including several stops, with a special train, about a month ago, the average running speed being 55.6 miles per hour.

The most serious railway accident of the week was a rear collision Dec. 8 on the Central R. R. of New Jersey at Greenville, N. J., in which 14 persons were more or less injured, five of them seriously, and one of them died in the hospital. The accident is of interest in that it happened on a road equipped with automatic block signals (Eng. News, March 29, 1890). Two westbound express trains, for High Bridge and Long Branch, were running about two minutes apart. The High Bridge express was stopped by the rear brakeman on the supposition that the train had struck a woman (who, however, had slipped in boarding an eastbound train). The train stopped with the rear end of the last car about 60 ft. within the block section, which put up a danger signal behind the train, at the same time releasing a danger (home) signal and keeping up a caution (distant) signal 1,800 ft. back, toward the approaching Long Branch express. The rules are that if an engineman comes to a block signal with a distant signal at caution, and the danger (home) signal down, he can proceed, "expecting to stop at the next block." Under this rule the Long Branch express passed the distant signal, but instead of reducing speed so that he could stop at the next block, as he should have done, and as the rules require, the engineman depended on the High Bridge express being out of his way, and came into the next block so fast that he could not stop when he saw the danger signal, and which, on account of the fog, he could only see when 200 ft. from it. The High Bridge train being only about 60 ft. beyond this signal the collision was inevitable. The accident occurred through disobedience to rules. The rule is absolute that a home signal at danger shall not be passed, under any circumstances, without first coming to a full stop, and the engineman's excuse that he could not see the next block on account of the fog is not accepted, as he had passed the distant signal which warned him to expect to stop at the home signal.

The Henley garbage crematory is being tested in Chicago. It has a capacity of 100 tons daily, and costs $10,000. The fuel used is petroleum, and 10 barrels per day is the consumption figured to generate 3,000° of heat. The interior of the furnace is lined with asbestos and fire-clay, and the grate-bars are also made of fire-clay. The cost of operating is stated to be $30 per day, and it is claimed that this furnace will not only consume garbage, but also night-soil, and do this without objectionable smell.

Plans for the tunnel which the New York, New Jersey & Eastern R. R. Co., proposes to build underneath the East and North rivers and Manhattan Island, connecting Brooklyn and Jersey City, are reported practically completed, and maps and profiles have been filed with the Register of Kings Co. According to the report the route will be from the Flatbush Ave. station of the Long Island R. R., in Brooklyn, along Flatbush Ave to Fulton St., along Fulton St. to Pineapple St., and thence under the East River to and along Maiden Lane and Cortlandt St., in New York, and thence under the North River to the Pennsylvania R. R. station in Jersey City. The total length of the tunnel will be 3½ miles, and its depth below the surface of the ground will vary from 19 ft. to 140 ft. Its width will be 20 ft., and its height at the center 27 ft. The borings thus far completed show that the tunnel will penetrate a compact gneiss rock throughout its entire length, except for a short distance under the North River where the rock dips below the tunnel level. The stations will be provided with elevators, and all necessary apparatus for handling both passengers and freight, and connections will be made with both the Brooklyn and New York elevated railways. The tunnel railway will be operated on the circulating system, by means of loops at the terminal stations, and a proper number of turnouts for the passage of trains at various points on the line. It is stated that all the necessary surveys and borings will be ready for beginning work in about a month, when we hope to give more detailed information in regard to the work. The plans for the work have been prepared by Mr. Chas. M. Jacobs, of New York city.

The U. S. Geological Survey now covers a total of 660,000 sq. miles, says the Secretary of the Interior in his last report. The mapping covers 300 large atlas sheets.

The high buildings in Chicago and elsewhere having a skeleton steel framework, are claimed to infringe upon the patents of L. S. Buffington, and the Buffington Iron Building Co., of Minneapolis, Minn., has been organized with a capital stock of $1,000,000, to sue for royalties on these buildings, and to manufacture the iron framework as well as all other material used in the skeleton construction of iron buildings, under these patents. Mr. Buffington claims a continuous skeleton of steel, with an exterior veneer supported on shelves, and a packing for the protection of the metal, and states that the first building with a skeleton of steel was built in 1889, after he had published particulars of a design for a 28-story building (Eng. News, March 31, 1888), and a description of his patent. He therefore considers that the buildings of this type are infringements on his patent, but whether such a very broad claim can be sustained remains to be seen; if it is sustained, he will have earned a large fortune very easily.

A novel idea in signaling has been worked out by Mr. C. V. Boughton, of Buffalo, N. Y., and was recently exhibited in that city. A vertical shaft 27 ft. high contains a row of 106 incandescent lamps, and by lighting or extinguishing them the row of lamps is made to display the characters of the Morse alphabet. A dot is shown by 2 adjacent lamps, a dash by 12 lamps and a space by 12 lamps unlit. The current to the lamps is governed by a complicated arrangement of switches, which are worked automatically from a typewriter keyboard. Thus pressing a given key on the keyboard will light and extinguish the proper lamps to display the signal for the letter printed on the key. The system is intended especially for use on shipboard, or wherever the stretching of wires for communication is impracticable.

A profile map for a new East River and North River tunnel was filed in the office of the Brooklyn Register on Dec. 6. This is the tunnel already described in this journal as proposed by the Long Island Railroad Company, to pass under the East River from South Ferry to the Battery, commencing at the Flatbush and Atlantic Avenue station of the railway company in Brooklyn. On the New York side it would tunnel from the Battery to Maiden Lane and thence under Cortlandt St. to the Hudson River. A project to be carried out later includes a tunnel under the Hudson River to the terminal stations of the Pennsylvania and New Jersey railways. It is said that the 18,000 ft. tunnel under the East River is to be commenced soon.

The Chicago University telescope, for which Mr. Charles L. Yerkes has contributed the cost, is to be made by Warner & Swasey, of Cleveland, O., excepting only the object glass. This telescope will have an object glass of 40 ins. clear aperture, and the tube with its accessories will be 75 ft. long and weigh 6 tons. The finished instrument will weigh 60 tons. The machinery will be operated by electric motors. The Yerkes telescope will have a magnifying power of 3,000 diameters and will exceed the power of the Lick instrument by 25%.

The comparative cost of railways and canals, in England, was referred to in his annual address by Mr. Harrison Hayter, President of the Institution of Civil Engineers. He quoted from the report of the Parliamentary Committee of 1883, to the effect that the average cost of English canals was $16,750 per mile as compared with $230,000 per mile for railways. The cost of maintenance on canals was less than one-fourth of that on railways, while the cost of conveying heavy materials on canals was less than one-third that of like service on railways. Mr. Hayter expected to see a lively reaction in favor of canals.

Street crossings of perforated metal are being tested at the intersection of Van Buren and Jackson Sts. with State St., Chicago. The sections are 3 ft. long and 1 ft. 5 ins. wide, and water and slush drains through into a trough. The experimental crossings are of iron, but it is proposed to make them of ¼ in. stamped steel. It seems, however, as though the crossing would be slippery. It is the invention of G. W. Doolittle, and the Perforated Metallic Street Crossing Co. has been incorporated.

THE NEW CONCRETE MASONRY DAM OF THE BUTTE CITY WATER CO.

A concrete masonry dam 120 ft. high is now being built near Butte City, Mont., by the Butte City Water Co. which within two or three years has gained possession of many of the sources available as water supplies for the city of Butte and which recently bought the works built in 1882-3 by the Silver Bow Water Co. The following description of the new dam, together with some information regarding the works of the company, was written the latter part of August, 1892, by Mr. Chester B. Davis, M. Am. Soc. C. E., of Chicago, who is engineer for the dam and the new works of the company:

The present supply comes from Basin Gulch, south of the city, through a box flume 10×10 ins. square, and but about 1,000,000 gallons daily can be had. It is pumped by steam to but a small portion of the city, that most thickly settled.

The Butte City Water Co. will build works to bring in all the water from Basin Gulch and from such adjacent streams lying higher up in the mountains as can be brought around into Basin Gulch by ditches and flumes, amounting in all to an average daily supply of about 5,000,000 gallons.

Later, when the consumption is such as to require it, the company will build works to bring a supply of from 12,000,000 to 15,000,000 daily from Jerry Creek and Divide Creek across the Continental divide, or main ridge of the Rocky Mts., from out about 22 miles distant from the city, at an additional cost of about $1,000,000.

The water-works to be built at present, aside from the distributing system in the city, which will be increased by 30 miles of mains, ranging from 5 to 20 ins. in diameter, will consist of a masonry dam 120 ft. high at mid-stream of the creek and about 350 ft. long on the crest; the shape and dimensions of the dam are shown by the accompanying drawings.

The dam is 10 ft. wide at the top and 83 ft. thick at the 120-ft. point, and is of a gravity section as shown in plan and section by Figs. 1 and 2.

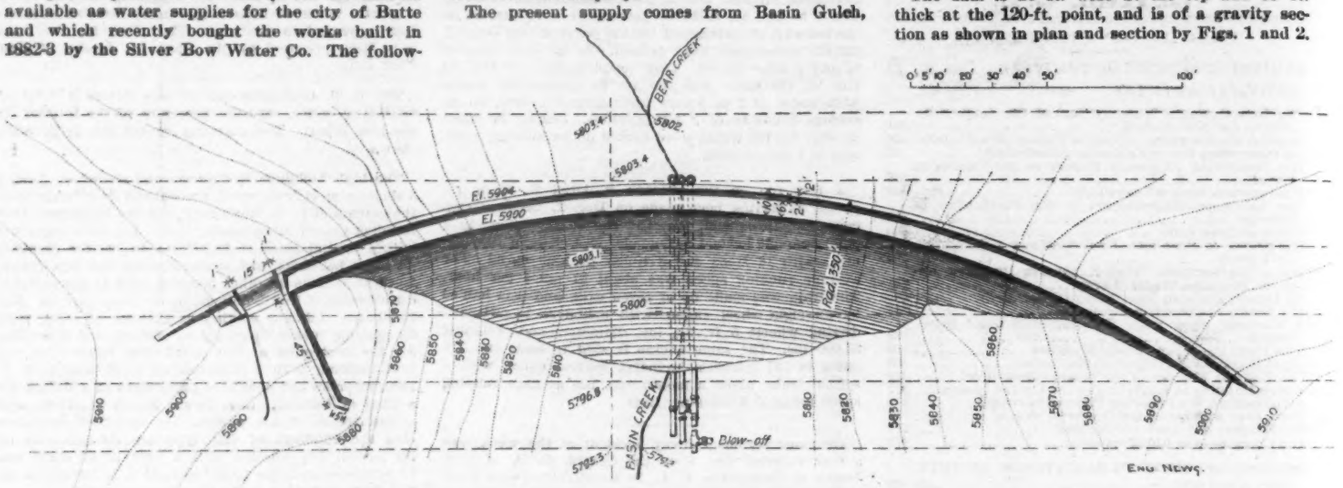


FIG. 1. PLAN OF CONCRETE MASONRY DAM, BUTTE CITY WATER CO.; Chester B. Davis, M. Am. Soc. C. E., Engineer.

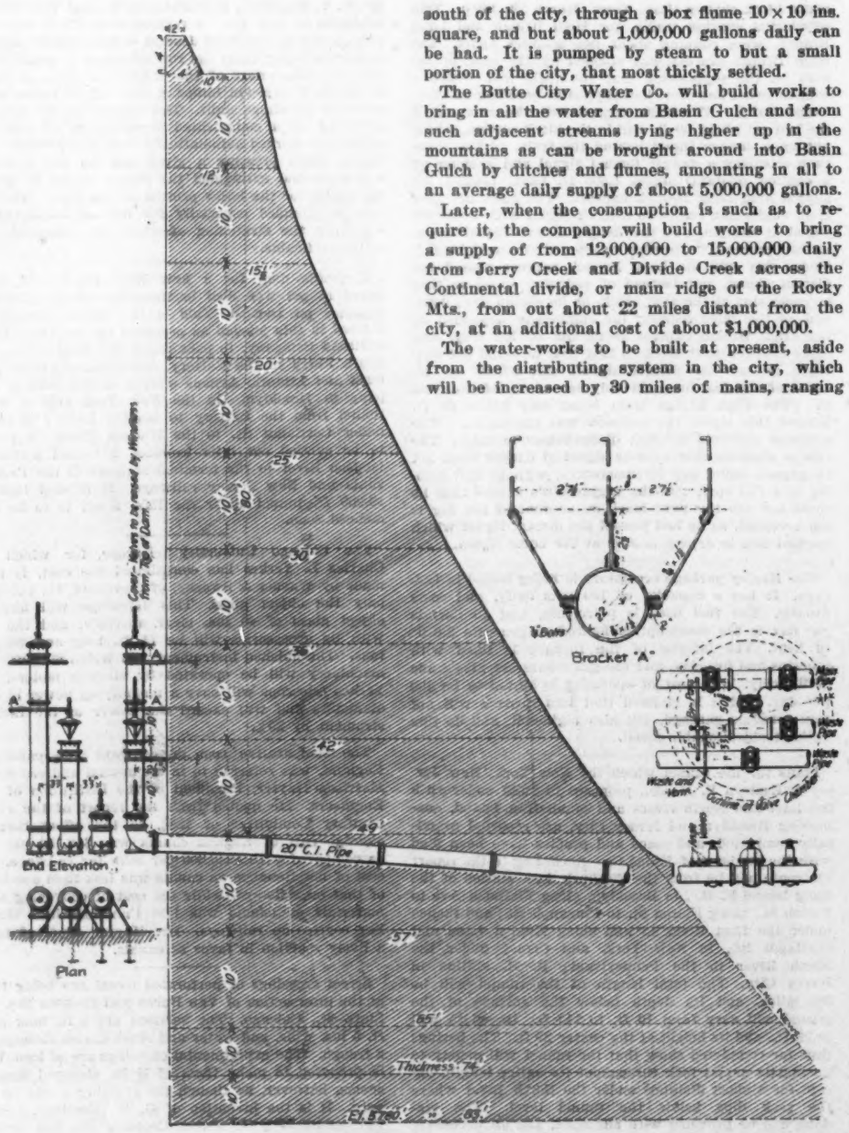


FIG. 2.—SECTION OF DAM AND DETAILS OF VALVES.

It is curved to a radius of 350 ft., it being found that owing to the shapes of the contours, there was a little less material required for the curved than for any straight dam that could be located between the proper places for abutments.

The waste weir is as shown in Fig. 3, having a width of 15 ft. The streams supplying the reservoir are fed principally by melting snows, it being a region of practically no rain; consequently there is little fluctuation in the amount flowing into the reservoir, and no need for a large waste weir.

The bed rock is granite, quite solid and free from seams at the east end; but in a portion of the bottom and in the west abutment, see Fig. 4 (the latter being a point at the junction of Bear Creek, with main creek), is somewhat broken up, the joints and seams being filled with talc (?) and decomposed granite.

The dam will be a concrete structure, Yankton Portland cement and crushed granite being used. It will be faced with a hard blue, granitic rock, found close by.

The dam is pierced by a 20-in. waste pipe and two 20-in. supply pipes, so arranged that either or both of the latter may be used as desired and so that all three may serve as waste or blow off pipes; they are arranged to take water from different depths.

The valve arrangement shown, makes all gates accessible and permits the taking apart of any of the main gates, without inconvenience. To accomplish this the upper end of the supply pipes, terminating within the reservoir, is provided with a valve seat on to which a cover valve of the form shown by Fig. 5 may be dropped from a winch, or windlass, to be located on the inner edge of the dam above.

A system of vent and priming pipes (Fig. 2), near the main valves, provides for the escape of air from the pipes in filling them and equalizing the pressure and permits the removal of the cover valve.

The water is conveyed to the city by a banded redwood stave pipe 24 ins. in diameter and nine miles long, which is being built under contract, by the California Redwood Co., and by a lap-welded steel pipe 20 ins. in diameter, and about three miles in length. Redwood pipe is used for pressures up to 200 ft. head and the steel for heavier pressures.

The crest of the dam will be 5,900 ft. above sea level. The elevation at Silver Bow Creek, in the valley below Butte, where the pipe line crosses, is about 5,280 ft.

In addtion to the above information sent by Mr. Davis we have abstracted from the specifications some of the most interesting requirements, as follows:

Whenever the slope of the solid bed rock of the dam site makes a greater angle than 5° with the

horizontal it must be rough stepped by removing the least possible amount of bed rock. Where the rock beneath the dam is smooth and free from cross seams it must be made rough either by stepping or by blasting holes with a superficial area of from 6 to 12 ft. and a depth of from 1 to 3 ft.

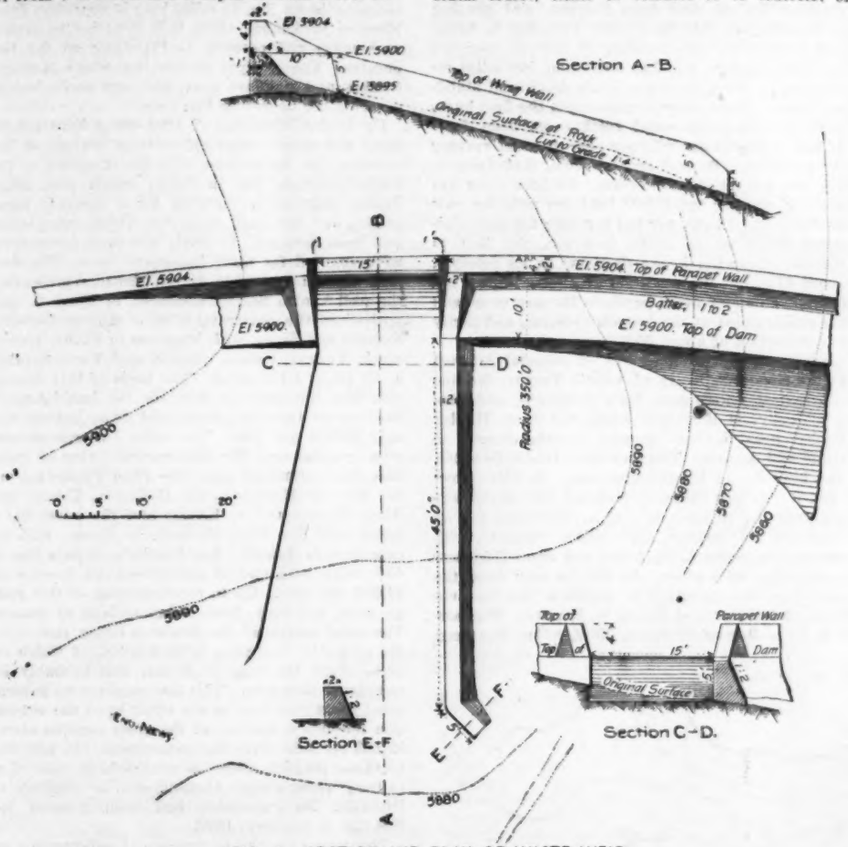


FIG. 3. SECTION AND PLAN OF WASTE WEIR.

Each square foot of the natural bed rock beneath the proposed structure and to include an area to an elevation of 20 ft. above the flow line and for at least 200 ft. above and 100 ft. below the upper and lower toes of the dam, must be carefully examined and everything not natural, true and perfectly solid granite rock over this area be removed.

Each crevice, joint, crack or other opening beneath the proposed structure must be examined and tested and all material removed which would be likely to be started or stirred by a pressure up to at least twice the maximum load on the base or abutments or by a minimum strain of 25 tons per sq. ft. Each crevice, joint, crack or other opening must be filled with granite or concrete after completing the blasting for the portion of the dam where located. Openings outside the limits of the structure must be filled flush with the surface and rammed where possible until perfectly compact. Openings beneath the dam must be treated in the same manner, unless large enough to be properly filled with the concrete used for the base of the dam. In all cases these openings must first be grouted.

The pipe passing through the base of the dam must be laid in a prepared channel with a chord equal to the chord of a quarter of the circumference of the pipe. After the pipe is placed in its channel, and before the concrete sets voids between the pipe and channel must be grouted with Portland cement and the concrete along the pipe tamped. The concrete while forming the channel and when covering the pipe, must be imbedded in at least 16 ins. of concrete before boulders are placed about it.

Regarding the body of the dam the specifications state:

The principal objects sought to be accomplished in the masonry part of the dam are: The use of the greatest volume possible of the granite boulders; imbedding each of them completely, in a mixture of concrete cemented firmly to every portion of its surface; placing the boulders in such positions, relatively, as to reduce the thickness of the concrete filling to the minimum, and so that there can be no horizontal or nearly horizontal course, either of boulders or of concrete; of facing the work on both sides (up stream and down stream), with selected boulders, and of finishing the top in such a manner as to carry along it, if necessary, the road now existing in the canyon.

The boulders must be cleaned from moss, vegetable mold and disintegration by a water jet, steel brush or otherwise.

The bed rock must be covered with at least 8 ins. of concrete in 4-in. layers. The lower layer shall have only half the amount of broken stone named below, which shall be of the finer screenings, and must be tamped. Where the holes in the bed rock are sufficiently large boulders shall be placed in them, on top of the first layer of concrete. In placing boulders a bed of concrete must first be prepared so that the lower part of the boulder will sink well into it. The concrete shall then be rammed beneath the boulder by edge tampers and around it by flat tampers.

Large stones may be placed as close to each other as convenient and part of the space between them may be filled with smaller stones.

Concrete must not be placed in layers of more than 8-in. thickness and horizontal courses over considerable area must be avoided.

The concrete used in filling crevices must be of 1 part Portland cement, 3 parts clean, sharp sand and 3 parts clean broken stone screened to pass through 1-in. ring.

The broken stone for the concrete in the body of the dam shall be of sizes allowing it to pass through a 2½-in. ring and shall be screened by passing through rod or revolving screens spaced 1 in. and ¼ in. respectively, to remove the dust and separate the stone for making coarse and fine concrete.

All cement shall be Portland so ground that not over 7% shall remain when screened through a sieve of 2,500 wire, or 80 meshes to the inch. The proportions of the parts of the concrete for the base are to be determined, in part, by experiment with the cement selected, but the broken stone will equal in bulk the cement and sand.

A letter from Mr. J. T. Harper, C. E., of Butte, dated Dec. 1, states that the dam has been completed to the countour 5,800 ft. above sea level, where the outlet pipes are located. Mr. Harper states that the area of the reservoir within the water line will be about 130 acres and that the estimated capacity of the reservoir will be 1,000,000,000 gallons.

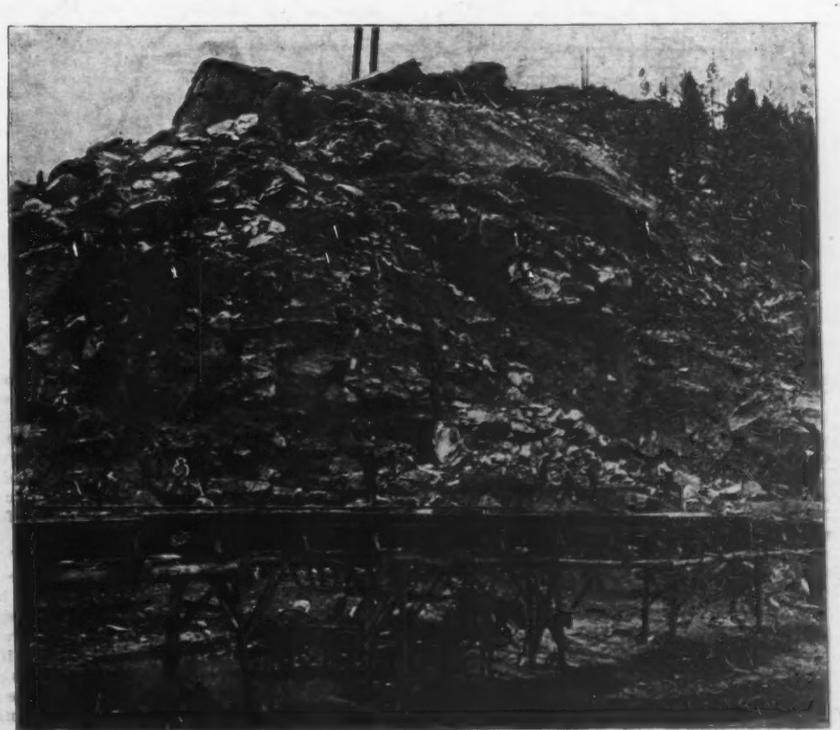


FIG. 4. WEST END OF DAM SITE, SHOWING FLUME FOR CARRYING AWAY THE WATER OF THE CREST.

RAILWAY CONSTRUCTION IN ASIATIC TURKEY.

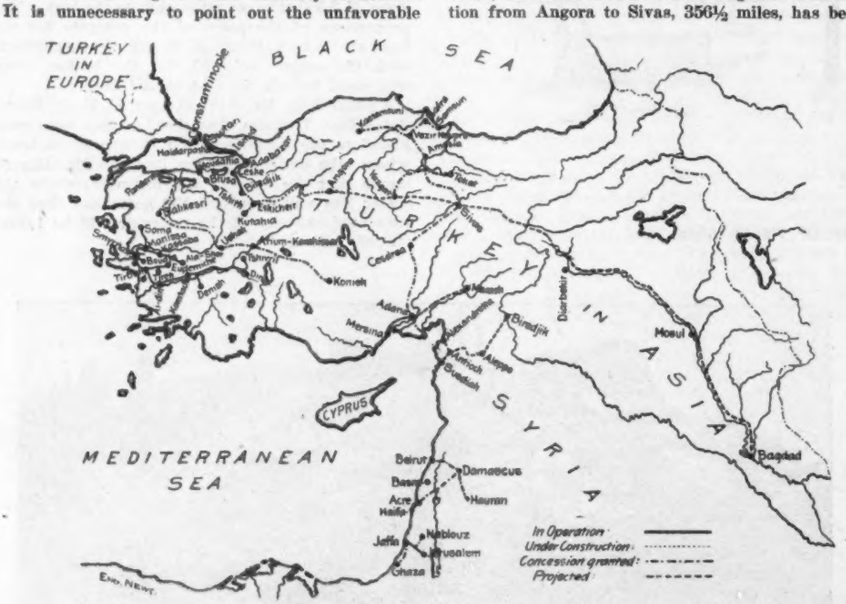
The completion of a line of railway from Jaffa to Jerusalem has naturally been widely heralded and commented upon by the newspaper press the world over. In truth it does seem something of an anomaly and to some of the ultra-esthetic it may perhaps appear even a greater sacrilege than the British tourist shooting on Mt. Sinai did to Mr. Ruskin. However, aside from the incongruity between the associations of the Holy City and its contact with that most material of modern innovations, the railway, the construction of this road affords contemplations of some interest. The extent, small as it is in comparison with most European countries, to which Asiatic Turkey is developing a railway system is hardly appreciated. With Turkey in Europe the conditions are somewhat different. Its closer connection with European countries and the important political interests at stake have been largely instrumental in introducing foreign capital into European Turkey, and the consequent advancement of its industrial condition. These considerations have been less prominent in that portion of the empire lying east of the Mediterranean.

Only a limited portion of the arable land in Asiatic Turkey is under cultivation. This is owing partly to the want of roads and the means of conveyance, which preclude the possibility of remunerative exportation, and partly to the system of levying a tithe on all produce, leaving no inducement to the farmer to grow more than is required for his own use or that in his immediate neighborhood. The agricultural development of the country is further hindered by the custom dues for the exportation of produce from one province to another. The mining laws are similarly restrictive. It is unnecessary to point out the unfavorable effect of such conditions upon railway construction. Nevertheless, owing to the enlightened position taken by the present Sultan, Abdul-Hamid II., considerable incentive has been given to railway construction during the last few years.

Under these conditions we have thought it of interest to show a map of the railway system of Asiatic Turkey as it stood in January, 1892, and to give some account of the various lines completed and under way. For the principal details which follow, we are indebted to a recent number of the "Revue Generale des Chemins de Fer." For a very complete description of the wagon road, and canal and river transportation system in Asiatic Turkey, we refer our readers to the issues of Engineering News for Oct. 31 and Nov. 7, 1878. A map and descriptions of some of the more prominent Indo-European railway projects were also given in our issue of Aug. 27, 1887.

The first concession for a railway line in Asiatic Turkey was granted to an English company in 1856 and authorized the construction of a railway from Smyrna, on the Mediterranean coast to Aiden and Diner, with the branches shown on the map. This line was completed and opened for traffic in 1860. In 1863 a concession was granted, also to an English company, for another railway, starting like the first from Smyrna, and running to Kasaba and Ala Sher, with branches to Soma and Bournabat. The mileage of railway operated by these companies is 313 miles and 164 miles respectively. Both lines are single track and standard gage. Their gross receipts from the first have, with the exception noted further on, been from $4,850 to $6,450 per mile per year at rates varying for passengers from 9 cts. per mile, first-class, to 4½ cts. per mile, second-class. Freight rates are about 8 cts. per ton (2,000 lbs.) per mile for raw products and 12 cts. per ton per mile for manufactured products. In 1890, however, the line to Kasaba showed a heavy decrease in its receipts, about 47%, but the condition of affairs is now improved. This was owing partly to the poor crops and the construction of the branch to Soma, and partly to a reduction of about 35% in passenger rates.

While these two lines are of especial interest as the pioneer railways of Asiatic Turkey, the line of greatest importance, both politically and geographically, is that now completed from Haidar Pacha, near Scutari opposite Constantinople, to Ismid and Angora. The section to Ismid, 58 miles, was built by an English company. In 1889, however, it was purchased by German capitalists who the year before had secured a concession for an extension to Angora, 300 miles further, with branches to Scutari, 2¾ miles, and from Eskicheir to Kutahia, 46½ miles. As will be seen from the map it is the intention to continue the line via Sivas, Diarbekir and Mosul to Bagdad. The section from Angora to Sivas, 356½ miles, has been carefully surveyed and the Sultan, who perceives the importance of the line, is actively interesting himself in securing its construction. There will, however, be some difficulty in inducing investors to take up an enterprise of such magnitude under present conditions and it seems doubtful if capital for its construction can be easily secured, even under the policy of government guarantees now in force.



MAP OF RAILWAYS IN TURKEY IN ASIA.

There are for this company a guarantee of a gross yearly income of $4,670 per mile of line operated. If the receipts from operation are less than this amount the difference is made up by a tithe levied on the Sandjaks, which correspond approximately to the Departments of France, through which the line runs. On the contrary if the gross receipts exceed the above sum the excess is divided equally between the government and the railway company. Thus far the receipts of the Angora line have been about $3,113 per mile per year.

The roadbed and track of this road are probably the best in Asiatic Turkey and will compare favorably with that of many European railways. The line is single tracked and standard gage. The rails are of steel weighing 60 lbs. to the yard and are laid on steel cross ties weighing 110 lbs. each.

In addition to the lines mentioned an English company has a line 45 miles long in operation from Mersina to Adana, which it is intended to extend to Marash and possibly to Biredjeck on the Euphrates. The receipts of this line which is single tracked and standard gage, are very small, hardly covering the operating expenses.

Up to the beginning of 1891 these lines constituted the entire completed railway system of the country, and, we believe, with the exception of the Jaffa-Jerusalem line in Syria, which with other Syrian railways is reserved for a separate paragraph, are the only lines for which concessions had been granted. In 1891, however, concessions were granted for three important lines. The first of these was secured by Baron Macar, representing the well known Societe Cockerill, of Belgium, and authorized the construction of a railway between Samson and Sivas, with branches to Tokat, Kastamuni, Yazgat, Cesara, Adana and Youmourtalik, in all about 1,116 miles. The basis of this concession was the same as that for the Ismid-Angora line, except that the guaranteed gross income was only $4,264 per mile. The other two concessions were granted to a Mr. Naglemaker. One of these was for a standard gage line from Panderma, on the Sea of Marmora, via Balikesri, Ushak and Afium-Karahissar to Konia; and the other for a meter-gage line from Mudania to Brusa, with an extension to Tchitli. The Panderma-Konia line is 434 miles long and is guaranteed an income of $4,050 per mile. Up to the beginning of this year no work had been done owing to lack of money. The total length of the Mudania-Brusa line, with the proposed extension, is 56.8 miles, of which 30 miles from Mudania to Brusa, will probably be completed this year. This line receives no government guarantee, but on the other hand the concession requires a division of the gross receipts above $3,113 per mile with the government. In addition to these projects there is considerable talk of a railway from either Alexandretta or Suediah to Biredjik. No concession had been granted for this line in January, 1892.

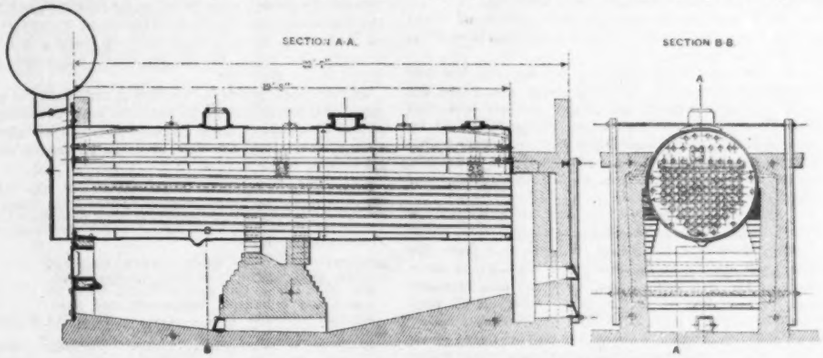
The four railways in process of construction or projected in Syria, are all narrow-gage (1 meter) and were all initiated by Turkish citizens. The oldest of these is that from Jaffa to Jerusalem, 49.6 miles, which, as noted before, has been recently opened for traffic. The concession for its construction was granted in 1888 to a Turkish citizen, but it was afterward purchased by a French company, which completed 27.9 miles in 1891 and the remainder during the current year. The line is operated by mogul engines built by the Baldwin Locomotive Works, of Philadelphia, Pa. No goverment guarantee is granted by the concession, which, it should be stated, permits the construction of a branch from Nablouz to Ghaza, 77½ miles. Somewhat later a concession was secured, also by a Turkish citizen, for a line from Beirut to Damascus, 74.4 miles. This concession was purchased by a French company, which proposes to use the Abt rack system for operating the sections crossing the Lebanon and Anti-Lebanon mountains, and requires the payment of an annual rental to the government. The same company also holds a concession for a steam tramway from Damascus to Hauran. The last line to be mentioned is projected to run from Acre to Damascus, with branches to Haifa, Basrah and Hasbeyeh. The concession for its construction was granted late in 1891.

It will be seen from the foregoing that the skeleton of a quite extended railway system in Asiatic Turkey has already been laid out. It will be some years to come, however, before we can expect the completion of these lines, and much longer before they are connected to form anything like a homogeneous system. Aside from the topographical and industrial difficulties, which are formidable, there is the necessity of overcoming a certain prejudice against new innovations which is characteristic with all Asiatic people. Last but not least is the question of traffic returns from railways which must, in part, at least, pass through sections that are comparatively barren of commerce.

AN INTERESTING BOILER EXPLOSION.*

By Fred H. Daniels.

Six years ago the Washburn & Moen Mfg. Co., Worcester, Mass., equipped a portion of their plant with a battery of six horizontal tubular boilers, from plans furnished by H. S. Robinson & Co. The boilers were 5 ft. in diameter, with tubes 19 ft. 8 ins. long, and were designed to carry a working pressure of 125 lbs. per sq. in. The advantages of subjecting materials for boilers to a careful test by the consumer, before accepting them, were brought to our attention by Mr. H. S. Robinson, senior member of the firm mentioned, and we decided to have all the materials for our boilers, especially the shell plates, tested in a very exhaustive way at the Watertown Arsenal, before permitting any of the material to be used. One plate out of the entire lot was condemned. These boilers have been in successful operation for nearly six years and are still in use. They are inspected every week. The water is run out, the manholes removed and the interior as well as the exterior of the boilers carefully examined. As the water in the streams in the vicinity of Worcester



FIGS. 1 AND 2. SECTIONS OF BOILER SHOWING POSITIONS OF RUPTURE.

is very pure, coming as it does from the granite hills, we never find scale in the boilers, but in the spring and fall, during high water, it is not uncommon to find a small deposit of debris, which is carefully washed out.

With all this care the accident was to us a real surprise. When it happened, the plant was running as usual, but the boilers were somewhat forced, although not to any extreme limit. Without any warning whatever, and with very little noise, the firing doors of the furnace were burst open, coal, ashes and water thrown out, and the boiler house, in an instant, filled with steam.

As soon as an examination could be made it was found that one of the plates in the third row, just over the most intense heat, had bagged and ruptured, leaving an orifice about 1 in. in diameter, thinning the metal around the orifice to a knife edge. The remainder of the shell was not damaged, because the boiler quickly emptied itself of water and steam, which extinguished the fire and cooled the brickwork. The accompanying drawings (Figs. 1 and 2), illustrate the exact location of the rupture, also the arrangement and details of the boiler and setting. A careful inspection failed to discover scale or debris of any kind inside the boiler. The other five boilers of the battery were also examined at the same time, and we found

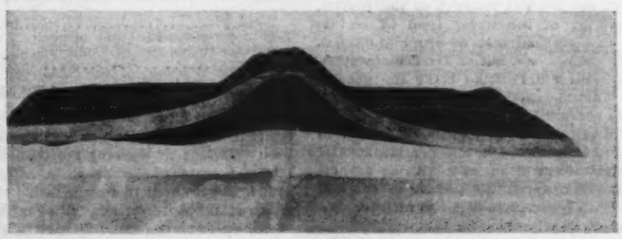


FIG. 3. VIEW OF RUPTURED PIECE.

two of them with their lower sheets slightly wavy, but nothing approaching a bag. The ruptured portion was cut out and a patch supplied in its place. The boiler has been in constant use since, without any further sign of failure.

Upon examination of the cut-out piece (Fig. 4), we found a very thin black scale around the rupture, and nearest the orifice it looked as if the plate had been highly heated, so highly, in fact, as to permit the

* Condensed from a paper presented at the New York meeting of the American Society of Mechanical Engineers.

cutting away of the hot metal. We carefully calculated the cubical contents of the plate (see Fig. 4), and found that there were 1.41 cu. ins. less material in the half 10-in. circle, after rupture, than there was in the plate before. These figures, together with a careful examination of the plate, seem to indicate that for a few moments before the rupture the plate was subjected to a very high, possibly to a white heat, and when the metal became sufficiently plastic and was in a proper condition for such a result, it simply flowed out, as shown in Fig. 4. It seems reasonable to suppose that this plate had been overheated for a few minutes only, and that previous to the time of rupture it had been in perfect condition, for the boilers were carefully inspected only four days previous to the accident, and everything was found in good order. Two or three times during the past 20 years we have had boilers bag, but never before had one rupture.

All of the shell plates in this battery of boilers were stamped with numbers, and the original report on the tensile strength tests preserved. By referring to these records we found that the plate which was ruptured had on one end a tensile strength of 68,050 lbs. and on the other end 65,650 lbs. per sq. in. It also stood well the "burr test" for annealing and water chilling. By way of comparison, two test pieces were planed from the ruptured plates. The test piece which was farthest from the bulge held 60,486 lbs. per sq. in., and had a reduction of area 41%. The test piece close beside the rupture held 61,666 lbs. per sq. in., and had a reduction area of over 32%. It will be observed that the tensile strength is considerably less in the ruptured plate than in the original tests of the plate. This may be accounted for, however, by reason of the test piece having a twist in it, occasioned by the bulge in the plate, and having been put into the testing machine without straightening. "Burr tests" were also made with good results (the specimens tested were exhibited at the meeting). The analysis of the ruptured plate is as follows:

Phosphorus	.061%
Sulphur	.022%
Silicon	.021%
Manganese	.261%
Carbon	.010%

It has been suggested that this thin scale covered the entire surface over the fracture before the rupture, and was caused by oil which had become burned on to the plate; but as the feed water for this plant was supplied from a closed heater, it is difficult to see how oil could have found its way into the boiler. We have been informed by Mr. Robinson that he was called a short time ago to examine a boiler of the same construction as the one referred to in this paper. It had been overheated directly over the fire box, making the shell plates wavy. After carefully drawing the water from the boiler, nothing could be discovered on the plate excepting a whitish powder. There was neither scale nor mud.

The conclusions the writer arrives at are, that the importance of mechanical, physical and chemical tests cannot be overrated. While the plate makers invariably subject their plates to tests and stamp them accordingly, at the same time, a confirmation of quality by the consumer is desirable, for we have seen that, in the tests at Watertown, one plate was condemned. If the ruptured plate had been of improper material or had contained sufficient carbon to harden when the water came in contact with the overheated plate, a crack might have developed, resulting in a serious explosion, possibly destroying the entire plant and causing a loss of life.

In closing, we wish to compliment Mr. H. S. Robinson, who constructed these boilers for us, upon the very perfect system which he has had in use for the past 19 years, of checking the tests of plates to be used in the work produced by his firm. During this time, all the plates of the boilers produced by them have been re-tested and a complete record preserved of the tensile strength and the "burr test," at the same time recording the location of each plate in the boiler by properly stamping them. This system is of great value to him and to the consumer, for any defects can then be traced and fully investigated.

Discussion.

A very long and interesting discussion followed, which, however, went far afield into general questions of boiler construction and inspection. Mr. Alan Stirling, the inventor of a successful vertical tube boiler, ascribed the difficulty in part to dirt and scale in the boiler, but chiefly to the fact that in a horizontal tube boiler of this type there is no sufficient chance for the steam to escape from the very point where generation is most rapid, and hence that the steel plate had a chance to bulge and deteriorate rapidly prior to the final catastrophe.

Mr. Jas. McBride showed drawings of a precisely similar case in a similar boiler in his own works at Brooklyn, with the sole exception that the danger was detected before rupture. They found the cause to be a simple one, dirt; and he thought that in every such case "if you get the dirt out of the boiler, you will get the cat out of the bag." It did not follow that the dirt would be easily detected in any ordinary cleaning, as it might be more or less indurated, and it would be very likely to be blown away in case of rupture. He exhibited a bulged piece from his boiler, corresponding closely with that illustrated, except that it was not perforated.

Mr. C. W. Nason knew of three separate instances where similar trouble was caused by small bunches of greasy waste left in the boiler. Prof. J. E. Denton called attention to the fact that a very thin scale, 1-32 in. or less, was often sufficient to alter materially the

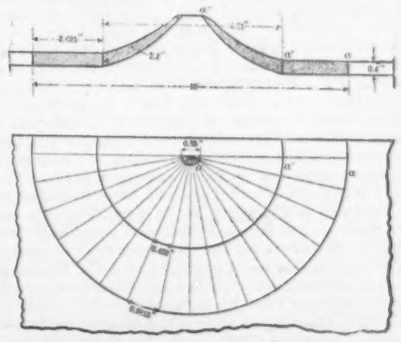


Fig. 4. Section and Plan of Piece Cut From Ruptured Sheet.

heat transmission, and even cause failure. Mr. Holloway thought if this was so it should go hard with the boilers with scale ¼ in. thick or more, which yet did not explode, and was disposed to think there must have been a blister or air bubble in the ingot. Mr. Platt stated that in English practice, owing to bad water, scale over ⅛ in. thick would form in a few weeks at times, and he had seen scale 1½ ins. thick. He urged the purchase of boilers only from large firms who were known to make careful tests of all the steel they used, and deprecated such purchases from "any little firm" who might to chance to bid lowest. Mr. R. W. Hunt followed humorously in the same view, urging the importance of inspection. Mr. Manning suggested that the trouble might have come from a sort of "grease and dirt pan-cake" adhering to this particular spot, as the currents tended to make it. He and others declared the application of fire externally to the barrel of a boiler to be false in principle.

Electric car lighting and the Shiels & Elliott electric signal between the cars and engine of a train, are in service on some trains of the Great Northern Ry., of Ireland. Gas lighting and hot water heating apparatus are being fitted to some cars on the Northern Counties Ry., of Ireland.

THE CONSULTING ENGINEER'S REPORT ON THE NICARAGUA CANAL.

The following is the report of the Board of Consulting Engineers appointed by the Nicaragua Canal Construction Co. to examine the plans, profiles, specimens of borings and estimates of the chief engineer, and to report upon the practicability of the scheme and its probable cost. The estimate of Chief Engineer Menocal, as submitted, showed a grand total of $65,084,176, as shown in parentheses at the side of the subjoined estimate; but it is but right to call special attention to the basis on which this estimate of the chief engineer was revised, as stated in the subjoined report; viz., to decrease no detail of the estimate, but wherever it seemed doubtful whether the estimate for any item was sufficient, to increase it to such sum as it seemed should be sufficient.

The subjoined report was prepared and submitted in May, 1889, but it was not made public by the company until very recently, in a publication of reports and facts as to the canal, containing a large amount of other information in regard to it.

To the Nicaragua Canal Construction Company:

Gentlemen: The undersigned were requested by your letter of Jan. 10, 1889, to examine the plans and estimates prepared by your Chief Engineer, Mr. A. G. Menocal, for a Ship Canal between the two oceans at Nicaragua, and to indicate the cost, in their judgment, of constructing a canal along the line proposed and following, in general, the plans of your Chief Engineer. You also requested an opinion upon the practicability of the canal as now proposed, with due reference to the end in view, namely, the safe and convenient passage of sea-going ships from ocean to ocean. We beg to present the following report.

We have carefully examined the unusually full maps, profiles, borings, samples of materials, etc., etc., which have been prepared and collected under the directions of your Chief Engineer, and the completeness and excellent form of which reflect credit upon your engineering staff.

We find certain elements of the design submitted which may probably be advantageously modified; this would, in some cases, reduce, and in others increase, the quantities. It is also altogether likely that some parts of the work may be let at lower, and other parts at higher prices than are estimated. We, however, are disposed to base our conclusions on quantities and prices which should prove sufficient to accomplish it upon the assumption of good and honest management, backed by an ample treasury. We have necessarily borne in mind the fact that the cost of the notable precursors of this canal project, both at Suez and Panama, has greatly exceeded the amount of the original estimates, and that this has been true of many other important works. While this might be, perhaps in a large measure, traced to unfortunate management as well as the lack of such careful preliminary studies as have been laid before us in this case, we have nevertheless endeavored to guard against a similar result by a liberal allowance for every apparent contingency.

Acting on this principle, we have not deemed it wise to reduce the quantities or prices of your Chief Engineer's estimates in any instance, even when it appeared possible that this might prudently be done. His figures are, of course, founded upon a better knowledge of the local conditions than we can now possess. But to the extent to which it has appeared at all doubtful we have liberally increased one or both. Our conclusions are as follows:

The project, as a whole, appears to have comparatively few elements of doubt about it, as contrasted with other works of at all similar magnitude, and we consider it to be unquestionably feasible. The great area of Lake Nicaragua offers immunity from serious floods by regulating flow. Much of the earth excavation and dredging, the rock drilling and the concrete mixing can be done by mechanical means, to that extent reducing the need for manual labor. The dams and embankments are proposed to be made largely from the immense mass of otherwise useless rock spoil. Under the climatic conditions, as we understand them, an adequate supply of labor should be obtainable. The project in detail consists of the following elements:

First. Of 10 miles on the east and 0.57 miles on the west end of sea-level canal dredged in from the coast. The borings submitted seem to warrant the opinion that this will be entirely through alluvial deposits, as is also the case in certain parallel river diversions. The samples of material taken from these borings all appear favorable for dredging, and the cost of such dredging can be foreseen with greater precision, because less influenced by climate, weather, and rates of wages than most other engineering work.

Second. Of a flight of three locks on each end, all within a distance of about one and one-half miles at one end and two miles at the other, by which the ascent is made from the sea-level to the summit-level of 110 ft., (this elevation being some four feet less on the eastern end to allow for a necessary fall of three-fourths of an inch per mile in the San Juan River). These locks are shown by the borings submitted to be all founded on rock. The proposed size for locks, 650 ft. by 70 ft. by 30 ft. deep, seems sufficient for all demands.

Third. Of a very long summit level of 155.98 miles, consisting of four main parts:

a—The great divide cuts of three and eight miles in length respectively which are shown by the evidence submitted to consist chiefly of rock, overlaid with a few feet of earth.

b—The Deseado, San Francisco, Machado and Tola basins, formed by dams, furnishing 21.57 miles of slack-water navigation, 18.13 miles of which require no excavation, and the remaining 3.44 miles earth dredging only.

c—The River San Juan, raised in level by a dam at Ochoa so as to furnish slack-water navigation, and Lake Nicaragua furnish, together, 121 miles of free navigation, of which 36.5 miles require some earth dredging and 3.83 miles some rock dredging.

d—An inconsiderable amount (1.63 miles) of canal section in earth, chiefly to connect the San Francisco and Machado basins.

The two great rock cuts are by far the heaviest features of the work. In considering the plans for them, and determining the proper amount and cost of work, we have felt that every provision should be made to secure permanent slopes and to provide a section suitable for any vessels which can pass the locks. We think that the estimates, as modified by us, will secure these results.

The four great basins present a most admirable feature of the plans. As compared with a restricted canal channel, they facilitate navigation as well as reduce the cost. They are made, as is also the slack-water navigation of the San Juan River, by dams and embankments of considerable extent, none, however, of very great height. The plans submitted provide for forming these dams and embankments chiefly of heavy rock filling, the proximity of the great rock cuts (from which material must otherwise be wasted) to the sites of these dams and embankments, facilitating their permanent construction at moderate cost. While we are not ready to say that the details of the plans submitted may not be, in some respects, modified, we regard the estimates adopted as sufficient to attain the results desired, subject to the following contingency.

There is the possible hazard in respect to the San Francisco and other basins, that they may not prove sufficiently retentive, owing either to leakage around the ends or under the bases of the dam and embankments, or to concealed permeable strata beneath the natural surface. We deem this a remote danger, since both the surface and subterranean formations, so far as revealed by borings and by the reports of the observations of reliable men, familiar with the locality, are favorable.

For a work of ordinary magnitude we would accept such evidence as ample, but, in view of the great area and volume of the basins, we agree that the possibility ought to be covered by the estimate. The probability is great that there are no permeable strata beneath the surface; if they exist they might not necessarily cause leakage, and even if leakage resulted it would not necessarily do serious harm. Concentrated leakage, if it occurred, might possibly be remedied, and, if it should develop at all, would be likely to occur at an early stage of the work of construction. The worst result to be feared is that it might compel a modification of the original features of the project, enforcing a lowering of the water level at certain points, and at an additional cost of about $7,000,000. Under the circumstances, we, out of abundant caution, have deemed it wise and right to make the general contingency of allowance ($14,633,262) large enough, in our opinion, to cover this amount.

The requisite depth in the San Juan River and in Lake Nicaragua is obtained by a considerable amount of dredging, largely of earth, but also with an amount of rock blasting under water, the precise extent and cost of which it is exceptionally difficult to foresee. We have therefore made an allowance for this work.

We have included in the estimates the sum of $1,035,000, for the diversion of the Rio Grande, as it seems proper to provide for the possible necessity of the diversion of this important stream from the canal. We have also included in the estimate the amount named by the Chief Engineer for the work that may be necessary in the valley of the San Carlos and in the construction of the canal between Lake Managua and Lake Nicaragua, this construction being a requirement of the concession.

The estimates for the harbor improvements at Brito and Greytown we leave unchanged. It appears probable that the amounts estimated may prove ample for all requirements other than gradual enlargement of basin areas, but whether so or not (and it is always extremely difficult to anticipate with certainty what may be the ultimate requirements for work of this class), we do not see the necessity in this work, as we do in the canal proper, for the endeavor to provide at the outset for all future demands of commerce. Sufficient expenditure prior to the opening of the canal to meet reasonable requirements for the first year or two after opening is all that we have taken into consideration in our estimates. The canal once opened, adequate harbors can certainly be provided at a moderate percentage on the total cost of the canal, even should the sum herein estimated for harbors and contingencies prove insufficient. We must not be understood as implying by this statement, however, that we now see reason to fear that the present estimate for harbor work will probably prove inadequate. Such is not the fact.

It may not be regarded as improper to mention also that while the cuts, locks, dams, etc., etc., should be completed for the full depths at the outset, something like one-fifth of the total amount of the estimate is for dredging and earth excavation under water, which is not required to afford 20 ft. draft, and which can be completed with little or no disadvantage after the canal has been so far constructed as to pass vessels of that draft, making it possible—if found advisable—to open the canal for 20 ft. draft for about four-fifths of the final cost.

Our estimate, which is intended to represent the maximum sum which the canal ought to cost, assuming, as aforesaid, integrity, good management, and no interruption of work from financial or other causes, is as follows:

(Note: We interpolate in parentheses in the following estimates the corresponding figures from Chief Engineer Menocal's estimate, that it may be seen wherein the chief increases were made under the conditions above stated.—Ed.)

Auxiliary railways, double track standard gage, from Divide Cut east to Greytown, and from Divide Cut west to Ochoa Dam, 20 miles and telegraph, temporary and permanent systems	($731,100)	$1,110,000
Same on Pacific Slope, Rio Lajas to Brito, 18 miles	(459,000)	459,000
		$1,569,000
Harbor Works, Greytown		$2,550,667
Harbor Works, Brito		1,720,128
		4,270,795
Carried forward		$5,839,795
Eastern Division:		
Brought up		$5,839,795
Section 1. From Greytown to the Divide	(3,950,523)	5,298,527
Section 2. The Eastern Divide	(11,786,107)	18,333,639
Locks Nos. 1, 2 and 3	(4,014,231)	4,195,828
Diversion of the Deseado and San Juanillo	(544,612)	982,016
San Francisco Division	(5,163,318)	5,411,551
Lake and River Division.		
Rio San Juan	($2,888,701)	$3,685,701
Lake Nicaragua	(1,857,825)	2,211,825
Dam at Ochoa	(726,137)	726,137
Western Division.		
From Lake Nicaragua to the Pacific	($9,753,849)	$12,133,849
Diversion of Rio Lajas	(305,785)	346,786
La Flor Dam	(577,520)	577,520
Locks 4, 5 and 6 and Guard Gates		3,899,116
Right of Way Indemnity		100,000
Auxiliary Work—Guard Gates in Divide, Piers at Lake, Bridges, etc. (same)		1,139,018
Embankments and Weirs in the Valley of the San Carlos, and canal between Lake Managua and Nicaragua	(275,000)	1,000,000
Diversion of the Rio Grande	(nothing)	1,035,000
For Engineering Management, Labor Agencies, Shops, Police, Sanitary Service and Incidentals	(about 5,000,000)	6,250,000
Total	($57,067,341)	$73,166,308
Add to cover specified and unspecified Contingencies of Construction, 20%	(8,016,835)	14,633,262
Grand Total of Estimate	($65,084,176)	$87,799,570

In conclusion, we think it proper to express our opinion that the exploration and studies of the region have been sufficient to warrant the conclusion that, unless hindered by obstacles or sinister influences such as would, if permitted to weigh, forbid the success of all ventures, this enterprise is full of promise.

Respectfully,

E. T. D. Myers, H. A. Hitchcock.
John Bogart, A. M. Wellington.

I concur in the foregoing estimates as being in the aggregate ample for the purpose stated.

Chas. T. Harvey.

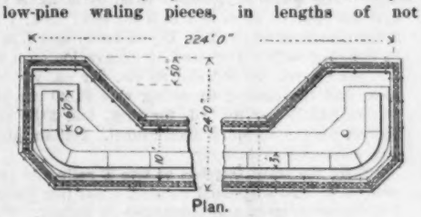
May 9, 1889.

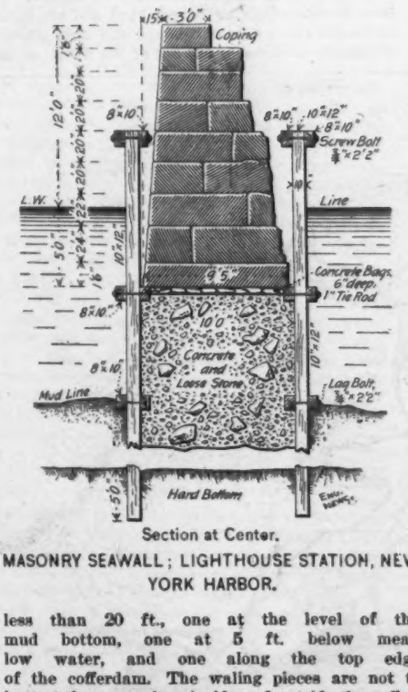
The Chicago Underground Subway Co. was incorporated in the city on Dec. 6, with a capital of $2,000,000. It is said that the purpose of the company is to build a 10-ft. subway under the old burnt district for the use of gas pipes and electric telephone, telegraph and lighting wires. The company expects to rent the subway space to any corporation applying.

MASONRY SEA-WALL.

A sea-wall of concrete and stone is to be built on the east face of the south side of the basin at the U. S. lighthouse depot on Staten Island, New York harbor. It will be 224 ft. long, 10 ft. wide at base and 8 ft. wide on top, with wider ends, as shown on the accompanying plans. The amount available for the work is $25,000, and proposals for its construction will be received until Dec. 21 by Major D. P. Heap, U. S. A., Engineer of the Third Lighthouse District, Tompkinsville, N. Y. The structure will be composed of a cofferdam partly filled with concrete surmounted by a stone wall eight courses high and a granite coping. The top of the coping must be brought to a level of 12 ft. above mean low water so as to bring it to the same height as that portion of the sea wall already built. The bottom is of mud at a depth of 15 to 20 ft. below mean low water line; and hard bottom, of fine sand growing coarser, at a depth of 38 ft. 2 ins. to 46 ft. 9 ins.

The cofferdam will be 10 ft. wide and 224 ft. long in the clear. It will be built of vertical yellow-pine timber 10×12 ins., driven down and into the hard bottom to a depth of 6 ft., if practicable. The sides and ends of the cofferdam must be secured horizontally by three sets of 8×10-in. yellow-pine waling pieces, in lengths of not





MASONRY SEAWALL; LIGHTHOUSE STATION, NEW YORK HARBOR.

less than 20 ft., one at the level of the mud bottom, one at 5 ft. below mean low water, and one along the top edge of the cofferdam. The waling pieces are not to butt at the same place inside and outside the cofferdam, but are to lap by at least 8 ft. The lower set of waling pieces will be bolted every 5 ft. with ¾-in. by 24-in. lag screws, and the two upper sets with ¾ in. by 26-in. screw bolts, and must be further strengthened by iron tie rods 1 in. diameter at intervals of 14 ft. passing through the waling pieces 5 ft. below mean low-water line.

After the cofferdam has been completed, the mud and soil will be pumped out to hard bottom and the bottom then covered with two layers of concrete in bags (the bags to be sewed so as to leave no fag ends) and the cofferdam then filled with concrete to 5½ ft. below mean low water, and the last layer of concrete allowed to set for 24 hours. The concrete will be composed of 1 part Portland cement, 2 parts of clean, sharp sand, 3 parts of pebbles, and 4 parts of broken stone not larger than will pass through a 2-in. ring. Large stones from 100 to 1,000 lbs. weight may be embedded in the concrete, but there must be at least 12 in. space between such stones. After the concrete has set properly the water will be pumped out and an additional 6 ins. of concrete laid in bags, on which the lower course of stone shall be set and well bedded while the concrete is green. If there is any deposit of mud or sediment at any time on concrete that has set, it must be washed off before the succeeding layer of concrete is placed.

The stone wall will be built of granite, Sandy Hill limestone, or such other stone as shall be acceptable to the engineer. The batter of the face to be 1 in. to the foot. The stones are to have dressed joints and rock face projection not more than 2 ins. and be laid in cement mortar of 1 part Portland cement to 2 parts of clean, sharp sand. The cement to be of the same brand as used in the concrete. The bottom or lower course to consist of all headers measuring not less than 4 ft. wide and 9 ft. 6 ins. long. The remaining courses shall be laid alternately, two stretchers and one header, breaking joints by at least 9 ins. The stretchers will vary in length, measuring not less than 4½ ft. and averaging 6 ft. long and not less than 2½ ft. wide. The headers will measure not less than 2 ft. in width and 6 ft. in depth, and extend through the wall for the four courses under coping. All the backing stone must be well bedded in mortar and all voids completely filled with mortar or fine concrete well rammed. All beds, builds, and vertical joints will be calked and each course grouted.

The coping stone will be of granite 3 ft. wide, 7 to 8 ft. long and 16 ins. thick. The face to be cut with a 1¼-in. chisel draft all around. The top and back to be rough, hammer-dressed.

Pockets 14 ins. wide and 12 ins. deep, from the beds of the coping and extending to the back of the wall, 12 ft. 6 ins. c. to c. will be built to receive iron girders. On the face of the wall, at intervals of 8 ft., the rock-face of the stone shall be removed for a width of 14 ins. to correspond with the batter of the wall and extend from the coping to the top of the concrete to receive fender piles. Iron fastenings for fender piles of approved design must be built in during construction of wall. Two cast-iron snubbing posts, one at each end, are to be built into the wall. When the wall is completed the inside sheet piling will be cut off at 1 ft. above mean low water, and the outside or face next to the bay at a level 4 ft. below mean low water line.

THE LAWRENCE EXPERIMENTS ON THE PURIFICATION OF SEWAGE IN 1890 AND 1891.

The commendable practice of purifying sewage before discharging it into water where in its crude condition it would give offense or be a menace to health is growing in favor in this country. This is shown by the large number of sewage purification plants of recent construction described in Engineering News since last June and the references to new purification projects which appear in our news columns with increasing frequency. The exact knowledge relating to sewage purification, either in this country or abroad, is very small. To that knowledge the State Board of Health of Massachusetts is a large contributor.

The report of the board for 1891 contains a detailed account of the experiments conducted in 1890 and 1891 at the experiment station, at Lawrence, on the purification of sewage and water. The account has been prepared by Mr. Allen Hazen, Chemist in charge. The following abstract from the report regarding the purification of sewage is in a sense a continuation of our review of the first two years of work at the station, given in Engineering News of July 11, 1891.

The work of the station is still under the direction of Mr. Hiram F. Mills, C. E., of Lawrence, a member of the Board. Mr. Geo. W. Fuller is in charge of the biological department and Mr. Harry W. Clark is assistant chemist. Prof. T. M. Drown and W. T. Sedgwick of the Massachusetts Institute of Technology, are respectively consulting chemist and biologist.

The experiments of the last two years have been almost or quite all with filtration through sand and gravel. For this purpose tanks of a known area have been used. These tanks are so arranged that the effluent can be secured, measured, and samples of it analyzed. Some of the tanks are out of doors, constructed in the ground, and others are under cover. The tanks out of doors have each an area of 1-200 acre, Nos. 1 and 2 being of this class.

The record of filter tanks Nos. 1 and 2 is covered for a second term of two years by the present report. Tank No. 1, during the years 1890 and 1891, filtered sewage at an average rate of 85,920 gallons per acre, daily, for every day of the period. It removed 94% of the organic matter, as shown by the albuminoid ammonia, and 98% of the bacteria of the applied sewage. Filter tank No. 2, during 1890 and 1891, has filtered at the rate of 49,360 gallons daily removing 97.5% of the organic matter and at least 99.99% of the bacteria. Correspondingly good results, Mr. Hazen states, have been secured with many other filters.

The filtering material in tank No. 1 consists of very coarse sand resting upon 3½ ins. of gravel of assorted sizes. The material in filter tank No. 2 consists of 5 ft. of fine sand.

The sewage used at the station is brought through about 4,300 ft. of 2½-in. pipe, in which a certain amount of insoluble matter is deposited, so that the pipe has to be cleaned at intervals. From analysis it appears that about 10% of the albuminoid ammonia, 6% of the oxygen consumed and a large proportion of the fats are retained in the pipe. The average composition of the sewage as received at the station during the past four years, in parts per 100,000, has been as follows:

	Ammonia.		Chlorine.	Nitrogen of		Oxygen consumed.	Bacteria per cu.cm.
	Free.	Albuminoid		Nitrates.	Nitrites.		
1888.....	1.5528	.6878	5.19	0	0	....	1,400,000
1889.....	1.8439	.5540	4.92	0	0	....	708,000
1890.....	1.8200	.6862	5.55	0	0	3.25	1,085,000
1891.....	2.2196	.7255	7.37	0	0	3.64	693,000
Average.	1.8597	.6644	5.73	0	0	3.44	871,000

Of course the detailed results of the experiments of the years 1890 and 1891 are far too extended to be published here, but in addition to the facts given some of the most important and interesting observations and conclusions are presented below.

It has been found that an excessive quantity of acid in the sewage prevents satisfactory purification by filtration through sand or gravel, but by adding limestone in the upper layers of the filters the acid is neutralized and good results are obtained.

As summing up in a few words some of the cardinal principles affecting the intermittent filtration of sewage the following paragraph is quoted:

The purification of sewage by intermittent filtration depends upon oxygen and time; all other conditions are secondary. Temperature has only a minor influence; the organisms necessary for purification are sure to establish themselves in a filter before it has been long in use. Imperfect purification for any considerable period can invariably be traced either to a lack of oxygen in the pores of the filter, or to the sewage passing so quickly through that there is not sufficient time for the oxidation processes to take place. Any treatment which keeps all particles of sewage distributed over the surface of sand particles, in contact with an excess of air for a sufficient time, is sure to give a well oxidised effluent, and the power of any material to purify sewage depends almost entirely upon its ability to hold the sewage in contact with air. It must hold both sewage and air in sufficient amounts. Both of these qualities depend upon the physical characteristics of the material. The ability of a sand to purify sewage, and also the treatment required for the best results, bear a very close relation to its mechanical composition.

Regarding the amount of sewage which a given filtering material is fitted to receive at one application it is stated that with coarser materials the dose is limited by the slight retentive capacity of the sand, since if too large a quantity is applied at one time a portion of it will pass through before complete oxidation has taken place. As a general statement it is said that sewage requires its volume of air for oxidation.

The frequency of applying sewage is of course varied according to material used.

The continued use of sand filters increases the amount of organic matter in the filters, especially in the upper layers, as might be expected. Occasional raking of the surface prolongs the life of the material, and occasional heavy doses increases the ventilation of the filter by agitation. Where the effluent is discharged into water used for drinking purpose heavy dosing cannot be rec-

ommended as it increases the bacteria in the effluent. The material at the surface of the filters may be removed when clogged, with good results. It gives no offense when stored, the organic matter which causes the clogging being very stable. Experiments are being made to determine whether this removed material will in time purify itself so that it can again be used. It is suggested that absolute rest of filter beds for an extended period, where possible, might be the simplest way of restoring their effectiveness, although the cost of land for beds and the cost of preparing the same might often render this impracticable.

The finer materials remove a greater proportion of the bacteria than the coarse and with the finest materials it is stated that there is reason to believe no bacteria pass from the top to the bottom of the filter.

Experiments to determine the effect of frost upon filter beds show that it checks both purification and nitrification, the removal of organic matter, however, being more complete than the oxidation of ammonia. The principal effect of frost at Lawrence lasts through not more than three months, when the effluents, during the past two years, contained about three times as large a proportion of the organic matters of the applied sewage as those from the same filters in warm weather. Loosening the surface of the filtering material with picks, when frozen, was tried on some of the filter tanks with good results. If filter beds can be kept clear of snow a great gain is effected, for the high temperature of the sewage is reduced by the snow and thus its power to thaw out the beds is lessened or destroyed.

Some of the other valuable matter in this report we hope to present in a later issue.

A NEW BELGIAN RIFLE.

The new Marga rifle and its cartridge are described in "La Reforme," of Brussels, under date of Oct. 18. Capt. Marga, the inventor, based his experiments upon the fact that with the quick powder now used, combustion is instantaneous and the expansive force of the gases acts with an extremely violent shock upon the base of the bullet, and this shock is resisted to some extent and force is wasted in overcoming the inertia of the projectile. In connection with an improved cartridge, made to meet the requirements outlined above, Capt. Marga has also invented a new rifle which he claims unites the three considerations of solidity, simplicity and security.

In lack of illustrations it can only be said now that the mechanism and manipulation of the new weapon are described as exceedingly simple, and as superior to the Mauser rifle. The cartridge is bottle-shaped and the bullet is plated with an alloy as hard as nickel. The peculiar feature lies in an inner copper tube filled with powder and upon the open end of which the base of the bullet rests. The detonator fires the powder in this tube first, giving the bullet an initial start forward, and at the same time the charge in the main cartridge surrounding the tube is ignited and brought into action. By this means a great increase in power and velocity is said to be gained. The charge of powder used is 2.50 grammes.

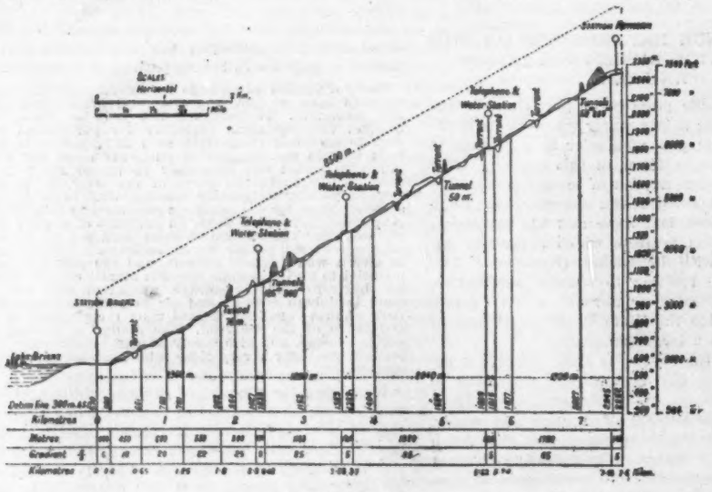
In the experiments made at Anderlecht, and reported in "La Reforme," the muzzle velocity with an 8 mm. rifle, ranged from 725 to 739 meters per second, with an average of 733 meters, or 2,404 ft. per second. With a 6½mm. rifle, the muzzle velocity ranged from 767 to 775 meters, with an average of 770 meters, or 2,525 ft. per second. The 6½mm. rifle gave a mean pressure of only 1,267 atmospheres. With both the 8mm. and 6½mm. rifles the bullet pierced 60 planks of dry soft pine each 2½cm., or 1 in. thick and placed 1¼ ins. apart. With the 6½mm. rifle all present testified that the last plank was as neatly perforated as the first. Experiments were made at the same time with the Mauser rifle, and with a charge of 2.75 grammes instead of the regulation 2.50 grammes, and only 47 of these planks were pierced by the bullet; and with an initial velocity of only 1,968 ft. (600m.) per second the Mauser rifle developed a pressure of 2,500 atmospheres. The experiments upon iron plates 16 mm. (.63 in.) thick were still more decisive. With the Marga rifle the plate was almost entirely penetrated, the imprint was enormous and the iron was torn. With the Mauser rifle the bullet only penetrated to about one-quarter the depth of the plate and the imprint was only half the size of that made by the Marga.

THE BRIENZ & ROTHHORN RACK RAILWAY.

(With inset.)

The prospect of securing a moiety of the enormous sum of money expended by the 1,500,000 tourists, who according to official figures visit Switzerland annually, seems to offer continued inducement for the construction of mountain railways in that country. The latest and in some respects the most interesting line to bid for a share of the ever increasing tourist traffic is that completed during the present year from Brienz to the summit of the Rothhorn, which we illustrate in the accompanying construction and equipment of mountain railways on the Abt system. The general plan and profile of the line are shown in Figs. 1 and 2. Its total length is 4.71 miles and the total altitude overcome is 5,517 ft., or 237 ft. over a mile. Starting from the steamboat landing at Brienz, the line winds up the declivity of the Rothhorn at a pretty uniform grade of from 20% to 25%, reduced to 5% at the stations, reaching the summit level by a series of serpentines with semicircular curves with a minimum radius of 197 ft. The changes of grade are effected by means of vertical curves having radii varying from 1,640 ft. to 3,280 ft. About 41% of the total length of the line is curve. Along the line there are 25 iron girder bridges (Fig. 8) and culverts, the former varying from 65.6 to 393 ft. in length, and six tunnels having an aggregate length of 2,640 ft. Five of these tunnels are through solid limestone rock, with openings on the lake side to afford a view, and one, 429 ft. long, is through a mixture of detritus and marl, and is lined with masonry. A typical section of the tunnel through rock is shown in Fig. 7. They are 8.85 ft. wide at the bottom, 9.84 ft. wide at the springing line of the arch on tangents, and 10.82 ft. wide on curves of 197-ft. radius, and 15¾ ft. high. The width of roadbed (Fig. 6) is 13.78 ft., and the ratio of slope is 1 in 5 for solid rock; 1 in 3 for retaining walls; 1 in 1½ in loose, and 1 in 1 in compact soils. The cost of excavation was 29 cts. per cu. yd. for soil and 88 cts. per cu. yd. for rock, and the cost of tunneling was $1.20 per cu. yd., or $45.75 per lin. yd. for rock, and $188 per lin. yd. for the masonry lined tunnel. Italian labor was employed exclusively.

Briefly the track consists of two T rails and two steel rack bars supported on steel cross ties placed 3 ft. apart c. to c. and embedded in ballast. The steel T rails weigh 40 lbs. per yard and are fastened to the ties by bolts, clamps and nuts made to fit exactly into spaces cut out of the flange or base of the angle bars at the rail joints. The ties are 5.9 ft. long and weigh 55 lbs. each. Owing to the large number of curves the rails were cut and bent to the proper form at the works and marked to insure correct and rapid laying. The two steel rack bars, (Figs. 10 to 14) which weigh each 35 lbs. per lin. yd., or 92.4 lbs. per yard with fastenings, are 6 ft. in length and have a fish plate at each joint. They rest on a ⊥ shaped chair to the web of which they are fastened by transverse bolts and



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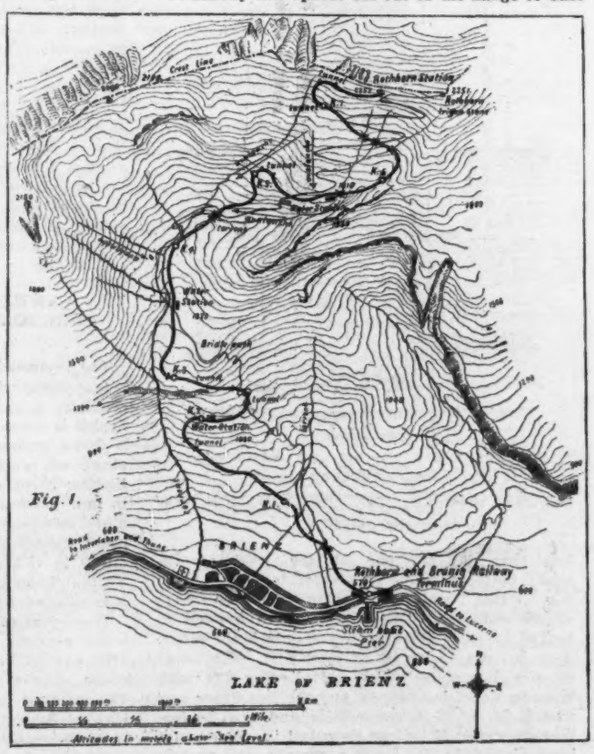

Plan.

BRIENZ & ROTHHORN RACK RAILWAY.

cuts and on our inset sheet. For these illustrations and the following details of the construction and equipment of the line we are indebted to a recent number of "Engineering."

In the beginning it is interesting to note that the at present the Brienz-Rothhorn line reaches the highest altitude above the sea level of any railway in the world. The principal interest which attaches to the line, however, is the fact that it probably embodies the latest improvements in the

nuts, the chair itself being fastened to the center of the sleeper by two vertical bolts and nuts, with intermediate nut rings. The teeth of the rack bars as well as their joints are differentiated and the simultaneous double grip resulting from this arrangement peculiar to Abt's system is again doubled by the number and the corresponding arrangement of the pinion wheels. The dimensions of the teeth are: 2½ cm. (1 in.) at right angles to line 5 cm. (2 ins.) at the base parallel to the line, and 4 cm. (1.6 ins.) in vertical height. The top of the rack is level with the tops of the rails except at switches and crossings where it is slightly raised.

At switches an interesting and comparatively novel device is used to effect the transfer of trains from one line of rails to the other. In the older lines of the Abt type this was effected by transfer tables, but for this slow and unwieldly process a new and effective crossing was first introduced on the Generoso line, and in an improved form on the Rothhorn line. Details of this device are shown in Figs. 15 and 16. Its construction and operation are as follows: Between the point of bifurcation and the frog are inserted two moveable rack bars forming a groin, and held by a hinge at the pointed end while the groin end is coupled with and governed by the switch. The motion of the switch bar when set for the crossing, causes the groin end of one of the rack bars to be pressed tightly against the rail, close on the other side of which is the odrinary rack bar, thus forming a continuous rack for the passage of the pinions over the point of intersection, while the groin end of the other rack bar simultaneously moves away from the other rail, thus leaving sufficient space for the passage of the ordinary locomotive and car wheels. To the groin bolt or bar connecting the two rack ends is fitted a reverse groin, which is formed of angle irons, and is loose at the pointed or frog ends. This piece, therefore, moves simultaneously with and in the same direction as the rack groin, so that the upper or horizontal flange of one angle iron overlaps the ordinary rail, while the other angle iron at the same time moves away from the other rail, and its vertical flange thus forms a guard rail for the passage of the ordinary wheels. None of the ordinary rails are cut or altered in any way, the rack bars being raised so that the outer circle of the pinion wheels does not touch the face of the ordinary rail. The number of crossings on the Rothhorn line constructed in this way are eighteen, and their successful use solves an important problem in rack railway construction.

In Figs. 17 and 18 the construction of the track at highway and timber road crossings is shown. The total weight of the track including racks, cross-ties and fastenings is 220 lbs. per yard, and the cost, including carriage and laying, was $5.80 for rails, cross-ties and fastenings, and $2.63 for rack bars and fastenings, making a total cost for track of $20,160 per mile. There are two terminal stations and three water stations on the line. A plan of the terminal station at Briens is shown in Fig. 19. All of the terminal arrangements are very simple.

Details of the Abt locomotives and other rolling stock used on the line are shown in Figs. 20 to 27, inclusive. The locomotives weight 13 tons when empty, and carry 0.7 tons of coal, 1.2 tons of water in the tank and 1.2 tons of water in the boiler, 0.9 tons of water for coaling, oil, tools, etc., making their total weight loaded 17 tons. This load is distributed over three pairs of wheels as shown in Figs. 20 and 21. The two sets of pinion wheels with which each engine is provided are fixed direct on the two front axles in order to reduce the engine load as much as possible. The other wheels run loose, the third being simply trailers added with the view of more equally distributing the load The motion is transmitted from the cylinders to the pinions without intermediate gearing, but through rocking beams, which admit not only of the cylinders being placed well back from the front of the engine, but also of a considerable length of stroke being used. The principal dimensions of the engines are as follows:

Diameter of cylinders	12 ins.
Length of stroke	22 "
Diameter of pinion wheels	22.9 "
" " wheels	20.1 "
Ratio of transmission of working beams	1 to 1.4
Rigid wheel base	4.62 ft.
Total " "	9.48 "
Firebox heating surface	39.83 sq. ft.
Tube " "	360.68 " "
Total " "	389.65 " "
Area of grate	6.65 " "
Pressure in boiler	206 lbs.
Tested Pressure	309 "
Total length, exclusive of buffer	18 ft.
Greatest height (inclination 12%)	9.84 "
" width	6.56 "

The principle of using the cylinders also as air brakes, which was first applied by Riggenbach on the Righi line, is used on the engines, the motion being, for that purpose, reversed on the descent, whereby the air sucked in at each piston stroke is pressed into the steam pipe and there stored until, after a few revolutions of the wheels without artificial letting off, its pressure arrests the motion of the pistons. For letting off the air, a special pipe is provided, which runs from the steam pipe to the driver's cab, where it is fitted with a stop valve, which during the whole of the descent acts and is regulated by the driver just as is the steam regulator on the ascent. The more the valve is opened the greater the speed, and vice versa; while upon the valve being shut, the train stops almost instaneously. Besides this air brake, each engine is fitted with two ordinary powerful screw brakes, one on the side of the fireman for stopping the train in stations or when switching, the other on the side of the driver, which is a safety brake in case the other two brakes should fail to act. Both these screw brakes act by lever transmission on discs fitted on both pinion axles, and each independently of the other is able to arrest the train almost instantaneously on the steepest grade. Each of the cars is similarly fitted with a powerful screw brake acting on a disc fitted on the pinion axle, the dimensions of the brake being: Radius of handle, 18 cm. (7.08 ins.); pitch of screw, 1 cm. (0.4 in.); radius of screw, 2 cm. (0.8 in.); ratio of transmission at screw-lever arm 1 in 4 and at blocks 1 in 4. The cost of each engine was $8,400.

The general design of the cars is shown in Figs. 22 to 25, inclusive. Two are for passengers only while a portion of the other is given up to baggage purposes. The total seating capacity of the three cars is 108 passengers. The two passenger cars have two four-wheel bogie trucks each, the pinion truck being fitted in the center of the end bogie truck, but the mixed car has but two pairs of wheels, the pinion wheel being attached to the axle of one pair. The trucks are shown in detail in Figs. 26 and 27. The three cars have a uniform width of 6.56 ft., and are 27 ft., 30 ft. and 21.3 ft. long, and weigh 5 tons, 4.5 tons and 2.6 tons respectively. The rolling stock as well as the track was built after Mr. Abt's designs.

The entire work of construction was carried out under contract by Messrs. A. Lindner, of Lucerne, and T. Bertschinger, of Lenzburg. Work was begun in July, 1890, and the line was completed and opened for traffic June 16, 1892. The total cost of construction and equipment, including stations and terminals and the interest during two years' construction, was $88,420 per mile.

AN IMPROVEMENT IN STEEL TAPES.

Engineers will surely appreciate the clever and simple improvement in the winding attachment of steel tapes here illustrated. The older and almost universal form of flush handle depended upon a stout thumb nail as an agent in opening it, and the experiences that too often followed have been provocative of language that if inserted in a Sunday-school book would certainly injure its sale.

This tape presents the same flush handle when closed and retains all its advantages. But the handle is opened by simply pressing a pin on the opposite side of the case. This pin pushes against the winding knob or handle when closed and thus lifts the cover. Closing the cover drives out the pin again ready for use. As shown in Fig. 1, a small pin-spring "C" holds the handle in place when closed.

Another and as decided an advantage of this device is shown in Fig. 3. This is that the handle, when open, swings out and doubles the length of the lever arm for winding, making this operation exceptionally easy and convenient. The construction of the tape allows a longer knob than usual to be used and thus permits a better and easier grip for the fingers.

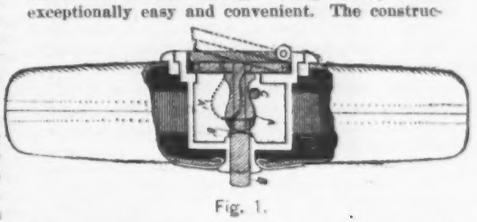

Fig. 1.

This device is the property of and is manufactured by the Lufkin Rule Co., of Saginaw, Mich., and we are told that it is sold at the same price as the tapes made by them on the older patterns.

TEST OF THE DAVIDSON TRIPLE-EXPANSION PUMPING ENGINES, BROOKLYN WATER-WORKS.

We are indebted to Mr. M. T. Davidson for the following record of a duty and capacity test made on two of the new triple-expansion pumping engines recently built by him for the Milburn station of the Brooklyn Water-Works. The engines were described and illustrated in our issue of March 12, 1892, and the boilers, which are of the return tubular type with internal furnaces, were shown in the same number. The run was made without any preliminary preparation, the engines being taken as they were running after having been in constant service furnishing a temporary water supply to the city for several months. The boilers had not been cleaned for several days; the regular firemen employed by the city were kept at work; and the coal was of fair average quality. There was a slight leakage of steam from the safety valves and considerable leakage from an expansion joint on the main steam pipe. The back connections to the boilers were uncovered, and the water tapped from the steam jackets went to waste.

Fig. 2.

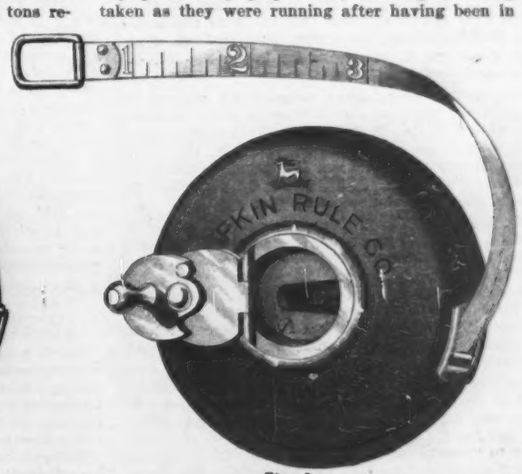

Fig. 3.

Engines Nos. 2 and 3 were tested together. Each has steam cylinders of 11½ ins., 20 ins. and 36 ins. diameters giving an expansion of nearly 10 volumes. Engine No. 2 has water cylinder 36½

ins. diameter, giving an expansion of nearly 10 3 has a 36-in. water cylinder and a stroke of 35¼ ins. The following are the principal data of the test:

Duration of test	8 hours
Strokes per minute, No. 2 (average)	59.9
" " No. 3 "	60.8
Mean piston speed, both engines, ft. per min..	179.4
Head by pressure gage on force main, ft.	35.11
Total lift by measurement, ft.	17.15
Total head on pump, ft.	52.26
Boiler steam pressure, lbs.	125.5
Jacket steam pressure, lbs.	52.
Vacuum in condenser, ins. mercury	26.5
Temperature of injection water	40°
" " air pump discharge	110°
" " feed water from heater	160°
Total coal fired, lbs.	4,800
" ashes, lbs.	503
" combustible, lbs.	4,297
" water pumped, gallons	9,119,328
" " " lbs.	75,963,307
Capacity of each engine per 24 hours, gallons	13,678,992
Duty per 100 lbs. coal, ft.-lbs.	82,706,033
" " " combustible, ft.-lbs.	92,388,140

The very low head under which the pumps work is of course unfavorable for the attainment of a high duty, especially with the high speed of the plungers. Notwithstanding the high piston speed we are informed that the pumps work very smoothly and quietly.

PERSONALS.

Mr. A. T. Shoemaker, dealer in railway supplies and equipment, has moved his office from 146 Broadway to 115 Broadway, New York.

Mr. J. B. Porter, Engineer of Maintenance of Way of the Cincinnati, Hamilton & Dayton R. R., has resigned and has been succeeded by Mr. I. J. Scott.

Mr. A. W. Quackenbush has resigned the position of Superintendent of Machinery of the Chicago & Alton R. R., and has accepted a similar position with the St. Louis, Cape Girardeau & Fort Smith R. R., with headquarters at Cape Girardeau, Mo.

Mr. Theodore Voorhees, General Superintendent of the New York Central & Hudson R. R., who graduated at the Rensselaer Polytechnic Institute in the class of 1869, delivered a lecture on "Transportation" before the students of that institution at Troy, Dec. 7.

Mr. J. W. Morris has been appointed Acting General Roadmaster of the New York, Pennsylvania & Ohio and Chicago & Erie Divisions of the New York, Lake Erie & Western R. R., with headquarters in Cleveland, vice Mr. A. Mordecai, promoted, to be Chief Engineer.

Mr. J. E. Matthews, Engineer and Roadmaster of the Western Maryland R. R., for 17 years, died of consumption, at Baltimore, Md., recently, aged about 50 years. He had been unable to attend to the active duties of his position since July, 1891, and one of his last works was the survey of the Potomac Valley extension.

Mr. J. B. Porter having resigned the position of Engineer of Maintenance of Way of the Cincinnati, Hamilton & Dayton R. R., to accept service elsewhere, that position has been abolished. Mr. I. F. White has been appointed Superintendent of Track and Structures, and will assume the duties previously performed by the Engineer of Maintenance of Way.

Mr. Geo. E. Mann, for many years City Engineer of Buffalo, N. Y., and Mr. L. H. Knapp, for many years at the head of the water-works of the same city, have both been removed for political reasons. Mr. S. J. Fields succeeds Mr. Mann, at a salary of $3,000 instead of $5,000, and he is an engineer of considerable experience. Mr. Knapp, an able and experienced man, is replaced by Mr. Drexilius, whose last office was that of Dairy Commissioner.

Prof. John Strong Newberry, of Columbia College, died at New Haven, Conn., Dec. 7. He was about 70 years old, having been born in Windsor, Conn., 1822. In 1855 he was appointed assistant surgeon and geologist to the exploring party that under Lieut. Robert S. Williamson examined the country between San Francisco and the Columbia River. In 1857 he accompanied in the same capacity Lieut. Joseph C. Ives in the exploration and the navigation of the Colorado River. The party spent nearly a year in exploring the Grand Canyon, and the results of Dr. Newberry's observations occupied fully half of the "Report upon the Colorado River of the West, Explored in 1857-8," published in Washington in 1861. His next exploration was of the country bordering the Upper Colorado and San Juan Rivers. After the war he was appointed Professor of Geology and Paleontology at the Columbia College School of Mines, and held the place at the time of his death. During his connection with the school he created a museum containing over 100,000 specimens. In 1869 Professor Newberry was appointed State Geologist of Ohio, and it was under his supervision that the geological survey of that state was pushed to completion. He also was associated in the work of the New Jersey geological survey.

NEW PUBLICATIONS.

THE TRANSITION-CURVE FIELD-BOOK. Containing Full Instruction for Adjusting and Locating a Curve nearly identical with the Cubic Parabola in Transition between any Circular Curve and Tangent. Simplified in application by the aid of a General Table, and illustrated by Rules and Examples. Also Tables of Radii, Sines, Tangents, Versines and External Secants. By Conway R. Howard, C. E. New York, John Wiley & Sons. 12 mo., flap, pp. 109, 49 pp. tables. $1.

THE RAILROAD SPIRAL. The Theory of the Compound Transition Curve, reduced to Practical Formulas and Rules for Application in Field-Work. With complete Tables of Deflections and Ordinates for 500 Spirals. By Wm. H. Searles, M. Am. Soc. C. E. 5th Edition. New York, John Wiley & Sons. 12 mo., flap, pp. 95, 42 pp. tables. $1.

We do not altogether approve of the methods for laying out transition curves given in either one of these works. They seem to us needlessly complex, and not sufficiently elastic and flexible. Either one of them, however, gives methods answering every purpose, for the only practical purpose is to make curves comfortable for the locomotive, and that end might be fully and satisfactorily secured by the following simple rule alone: "Never start a curve from a tangent direct, but start it from a tangent at an offset from the main tangent. Let the offset be 6 ins. or so per degree of curvature, bisect the offset for the center-line of track, and trust the rest to luck and the trackman's eye. It may as well be done in the first place, for it must be done in the last place anyhow."

Mr. Searles, however, so far as we can judge from his book, would look with horror and aversion at any such rough and ready rule as this. He has even no better to say for any system of offsets than to stigmatize it as "fudging," a remark which he will permit us to say is thoroughly unscientific. Geometric accuracy is not an end in railway location, as it is in ordinary surveying, but only a means to an end. Only so far as is necessary to the end is the means justifiable. A book inculcating the contrary must necessarily have many faults for the practical guidance of practical work; and this one has such faults, which we have pointed out in a prior notice, and need not repeat. It also has the good point, however, of enabling mathematical purists to accomplish a needed and much neglected end in the only way which their sense of professional dignity will permit them to use, and hence it fills what was a yawning void in technical literature.

Mr. Howard's book is pitched in a lower key of geometric precision, and by so much is more practical and better. We deem it by much the best of the two for practical use, and, in fact, a thoroughly good little manual for its purpose. The method is simple, with the sole great fault that it is not sufficiently elastic, but it is more elastic than appears at first sight, and perhaps sufficiently so for all essential ends. Mr. Howard correctly assumes that in general the handier way of running in a transition curve may be by angles direct, as it is especially by his formulas, but he gives the other method also for those who prefer it. He does not give it in its best or most convenient form, however, for he assumes the entire curve to be laid out by offsets from the tangent only. This may be well enough with short curves of small total offset; but otherwise by far the better and quicker way is to lay out half the curve only by offsets from the tangent, and the other half by identical offsets from the circular curve extended, which is run out to include the whole central angle for this purpose only.

ENGINEERS SURVEYING INSTRUMENTS: Their Construction, Adjustment and Use.—By Ira O. Baker, C. E., Prof. C. E. Univ. Ill. New York: John Wiley & Sons, 12mo, pp. 391; 86 cuts. $3.00.

This is a most excellent work, reflecting great credit upon its author, who has the gift of writing good practical text-books, suitable for students, but readable and instructive to the seasoned veteran also, as much as any man we know.

The distinguishing merits of the author's treatise on "Masonry Construction," which we had occasion to compliment highly when published, are visible also in this work. It is up to date; it is full of sound practical hints which did not come from other books, but were personally gathered; it gives plentiful records of the results of actual experience.

It is also much more than its title implies. It is not merely nor chiefly a treatise on the anatomy of field instruments, such as might be compiled with little labor from the voluminous publications of instrument makers. It is rather a "Manual of Instrumental Field Work," and such it might better have been called, with perhaps some slight abbreviation of matter easily found elsewhere about construction details, and some slight further expansion in the direction implied by the title suggested, but without any material change in its nature. Not to do this, we fear, was a business error. Few men care to buy a book on "Surveying Instruments." Dealers distribute too many such gratis. But many who may not buy this work under its present title, would have been glad to do so had the title been more descriptive of its real nature. Fortunately students have their thinking done for them on such subjects, and as a college text-book it is far and away ahead of any other known to us on its subject, with the partial exception of two or three excellent works which in part only occupy the same field and in part a different one.

The only criticism which we feel called upon to make are on some details, chiefly of omission. On p. 4 the small but necessary atom of knowledge that a chain is gathered up double by starting from the middle point is not noted. On p. 14 "fore" chainman and "hind" chainman seem to us awkward and unusual terms. "Head" and "rear" chainman are the all but universal names in railway work at least. Also, "the hind chainman has the more responsible position," only in compass surveying. In all transit work the head chainman is not only the most important of the two but the most important of the party for getting it along. The judicious chief of party is particularly careful in selecting him. All outline of the routine of his work in railway practice is also omitted in the chapter on chaining. It differs radically from "stick, stuck" chaining, and some very important practical hints might have been given.

On p. 23 the process of correcting for temperature is not sufficiently elaborated. Nine men out of ten do it wrongly at times if they do it at all. There are four different cases:

If tape is too long, add correction if measuring a distance; subtract correction if laying off a distance. If tape is too short, vice versa.

The ordinary tape of 30 years ago sagged so as to shorten about 0.01 ft. if 50 ft. long, and 0.03 ft. if 100 ft. long, with 8 lbs. tension. How is it now?

On page 32, we do not find the "one up, two down" rule for setting the transit legs on a side hill, nor directly (though we do impliedly) the general rule: Set two legs about right, to bring the plate reasonably level with plumb-bob in line for the plug; then move the third leg in or out to bring the plumb-bob over the point, and then move it sidewise to level the plate without moving the bob.

On p. 102 it is quite too casually remarked that the transit compass is "also useful" as a check against gross errors in reading the vernier. It is the worst of practice not to use it invariably to check every angle or every other angle in continuous line work.

The practical hints on p. 116 (like many others which we have passed over), are good and to the point, but we think they inculcate a little over-looseness in leveling up instruments. It is so little trouble to do so that we hardly approve of doing any transit work without first leveling up. By the way, a practical rule for leveling up, which the present writer fell back upon during many years of field work without ever outgrowing its usefulness, we find nowhere in the volume. It is:

"The bubble moves with the left thumb."

In all random line work with the transit, such as that in Fig. 30, p. 122, or in all railway preliminary surveys or resurveys, it is infinitely the best practice to start with the vernier reading zero when the compass reads N., and deflect right or left without ever resetting the vernier. The compass and vernier readings then always correspond, and the notes as taken are in shape for plotting or computing the traverse without correcting. This method is noted, but hardly with special approval.

The same principle applies to the plotting of such notes (a subject not touched upon in this volume, though it well might be). This should always be by bearings; never by angles. We hope every college professor teaches his students this. If he does not, he inculcates bad practice.

The objection to the ordinary New York level target, that it requires the cross-hair to be set on an edge, is given, but we find nowhere stated the general principle that in all careful instrumental work, it is more accurate to bisect a considerable surface with the cross-hair than to try to set it on a line or edge. We have known men who thought they understood fieldwork who were not happy unless they could conceal the object sighted at with the cross-hair.

There should have been a note that in running all transit lines the observer should at once pick out some foresight (if he can find one easily, as he usually can) by which to check against any movement. It is better than relying solely on a back-sight even if we can count on always having one. We suppose the old "difference" methods of keeping level notes has advantages which we are unable to perceive since so many people cling to it. It appears to us awkward and cumbrous to the last degree, and needlessly confusing to students to be drilled in it. It is fully given in this work, however, with the true remark that it is "not much used in this country, but apparently it is the favorite with British engineers."

The volume closes with an excellent schedule of practical exercises for the instruction of students in instrumental fieldwork. Two excellent ones we do not see, however—the running of complete circles with transit and chain and with chain only. There is no better exercise than running in such circles with varying degrees of care around some college building on a time

limit, especially if the same exercise is afterward repeated on the roughest accessible ground.

The copious notes scattered through this volume on the degree of precision in practice attained by various ways of using the various instruments are alone of great value and interest. They could only be found elsewhere by prolonged search through current engineering publications.

ORIGINAL PAPERS ON DYNAMO MACHINERY AND ALLIED SUBJECTS.—By John Hopkinson, M. A., D. Sc., F. R. S. New York: The W. J. Johnson Co., Ltd.; 12mo, cloth; pp. 249; 98 illustrations. $1.00.

This is a reprint of various papers presented by the distinguished electrician named above before the British engineering and scientific societies during the past 13 years, with one paper published in the "Philosophical Magazine" and a report to the Westinghouse Co. on a test made about six months ago on two 6,500-watt transformers. The principal topics considered in the papers are the theory and design of direct current and alternating dynamos, and of converters, and the principles governing electric lighting. There is also a description of two electric lighthouses which was presented before the Institution of Civil Engineers in 1886.

HINTS TO GAS CONSUMERS on the Proper Use and Management of Gas.—By Wm. Paul Gerhard, C. E., Consulting Sanitary Engineer. Published by the Author. 8vo, pamph., pp. 28.

The hints given in this little pamphlet to householders, and to gas consumers generally, on the management, the proper application and the economical use of gas for lighting purposes, ought to prove interesting and useful to gas consumers. They appear to be derived partly from personal experience and observation, and partly gleaned and compiled from various sources.

FACTS ABOUT SEWERAGE AND OTHER PUBLIC WORKS.—By D. A. Poyner. Pamph., pp. 12.

This little pamphlet was designed for private circulation in Texas. Aside from some popular matter, it contains a diagram for determining the size of sewers, and a table giving the cost of water pipe in place in Dallas. The diagram and the table were prepared by Mr. F. E. Snyder, Assistant City Engineer of Dallas.

STATE BOARD OF HEALTH OF CONNECTICUT: Report for the Year Ending Nov. 30, 1891, with Registration Report for 1890. C. A. Lindsley, M. D., Secretary. 8vo, pp. XXXVII., 447; Registration Report, pp. 202.

In some matters the State Board of Health of Connecticut is following in a commendable manner the example set by the Massachusetts Board. This is notably true as regards the examination of the water supplies of the state.

The first systematic examination of water supplies was begun Aug. 2, 1889, under a legislative appropriation made available July 1, 1889, and was continued until July, 1891, a period of 23 months. During this time samples were collected, either for a whole or part of the period, from 15 different sources, representing the water supply of 13 cities, boroughs and villages comprising about 44% of the total population of the state. All of the supplies were from storage reservoirs and most of the samples were collected directly from the reservoirs, the remainder having been taken from taps or faucets.

The investigations were made under the direction of Profs. C. A. Lindsley and Wm. H. Brewer, of the Board. All of the analytical work was done in the laboratories of the Yale Medical School. The chemical analyses were made under the direction of Prof. H. E. Smith. The microscopical examinations were made by Prof. S. W. Williston until July, 1890, and by Dr. T. G. Lee during the remainder of the period. Dr. Lee also made the bacteriological examinations and Dr. Chas. J. Foote made a detailed study of the methods of growth of a number of water bacteria.

The report contains the detailed results of the examinations mentioned, illustrated by separate diagrams for the chemical and biological examinations. Most of the diagrams showing chemical analyses also present the rainfall for the previous month, while some of the bacteriological diagrams show the rainfall and mean temperature of the air for the previous month and the temperature of the water for the same month.

These examinations cannot fail to be of value to the people of Connecticut and are a valuable addition to the general fund of available information regarding the character of water supplies. It is highly desirable that they be made a permanent part of the work of the Board.

In addition to Professor Smith's chemical analyses of water supplies, he contributes to the report a paper on the Connecticut River, with the results of analyses of its waters taken at three different points, some miles apart. The paper concludes as follows:

It would seem to be clear, that although the sewage entering the Connecticut River is so largely diluted as to have a scarcely perceptible effect on the chemical composition of the water as a whole, it is unsafe for drinking at any point in this state. As far as is known to the writer, no provision is made for its use as a public supply except at Hartford, where it is intended to be used as an emergency supply only. The analyses afford no evidence that the river is sufficiently polluted to make it a sanitary nuisance to the towns through which it flows, except it be used for drinking. That the contamination is sufficient to be a cause for the reported diminution of the fish of the river, appears to the writer to be doubtful.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF IRRIGATION ENGINEERS.—The annual meeting will be held at Denver, Colo., Dec. 28. The Denver Society of Civil Engineers has extended the use of its rooms, and excursions will be made to several irrigation works and other points of interest, and it is believed that the meeting will be one of great interest. One of the principles of the association is the presentation by each member, annually or oftener, of a paper on irrigation, forestry or cognate subjects. No one matter will, it is believed, more thoroughly conduce to the benefit of the Society and to that of all irrigation engineers, and of men building and managing irrigation works. Such papers will be published in a "Year Book." C. L. Stevenson, Secy., Salt Lake City.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—At the meeting at the Society's rooms on Dec. 9, a paper on "Plumbago and Some of Its Uses" was read by Mr. J. F. Torrance, and the discussion on "Transition Curves" and "Quadruplex Telegraphy" was resumed.

C. H. McLeod, Secy.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Dec. 7, Mr. Cohen, president, in the chair, a paper on "Asphaltum Lining of Reservoirs," by Mr. J. D. Schuyler, was read by the secretary, and an abstract of this is published in another column. In the discussion, Mr. Whinery said that the coefficient of expansion of asphalt on streets is about that of wrought iron. Below 30° F. it becomes so brittle that it will crack. Bitumen mixed with sand is more or less porous, and asphalt pavement will absorb about 3 to 4% of moisture and will gradually soften. Mr. Harris and Mr. Crowell thought that the good results obtained by Mr. Schuyler were largely due to the use of a thin coating, and its consequent elasticity. Mr. Collingwood thought that the asphalt would undergo a gradual chemical change, and become brittle, but Mr. Whinery stated that in asphalt pavement there is little change immediately below the surface.

Mr. W. B. Parsons read a short paper on the borings made along Broadway, New York, by order of the Rapid Transit Commissioners, in connection with the proposed underground railway. Holes were sunk to rock at every street intersection, using a 2-in. pipe with ¾-in. wash pipe inside. The pipe was first driven down by a portable pile driver, and then by hand. There were three men to each machine, and several machines were at work at the same time. The material was mainly sand and gravel, and was collected in boxes. Mr. Harris asked how it was possible to tell whether solid rock or boulders were struck, and Mr. Parson explained that this could only be done by driving two or three holes and comparing the results. The depth to rock at Canal St. was 87 ft.

The following candidates were declared elected: Members: Wm. H. Brown, Chf. Engr. Pennsylvania R. R., Philadelphia, Pa.; Howard Constable, architect and engineer, New York, N. Y.; Edmund G. Spilsbury, Man. Director, Trenton Iron Co., Trenton, N. J. Associate Members: Henry F. Baldwin, Chf. Engr., Chicago & Eastern Illinois R. R., Chicago, Ill.; Edward T. McConnell, Engr. M. of Way, Peoria & Eastern Ry., Indianapolis, Ind.

LIVERPOOL ENGINEERING SOCIETY.—At the third meeting of the session, on Nov. 23, Mr. Robert E. Johnston, Vice-President, in the chair, the evening was devoted to the adjourned discussion upon a paper entitled "The Development of the Machinery of Atlantic Liners," read by Mr. A. J. Maginnis, at the last meeting (Eng. News, Dec. 8). Mr. Maginnis made a few remarks in further explanation of his paper, and was followed by Mr. J. B. Edmiston, who pointed out the value of and the manner in which instructive tables might be prepared on the subject. He differed from the author of the paper, and instead of looking upon the locomotive boiler as the marine boiler of the future, he thought that the water tube boiler would be brought forward and play an important part as the future steam generator for marine purposes, and pointed out the many improvements which had been and were being made in this class of boiler. Mr. G. H. Little, who followed, thought that Atlantic liners were eulogized too much at the present time, and that as samples of high class marine engineering they were not at all up to the standard of many vessels in the royal navy. Captain Nowell spoke from the point of view of a navigator of steamers and not as an engineer, and agreed with the author in recognizing the great improvements which had been effected in every department of Atlantic marine engineering. Mr. Watt dealt principally with the reduction of weight which would have to be effected in machinery if in the future speeds were to be increased at the same rate as of late years, and pointed out the difference in the practice of the Royal Navy and the mercantile marine in this matter. He also thought that the water tube boiler was destined to help very much in the future, and instanced many of its advantages. Mr. W. E. Blackburne pointed out an instance in which this latter type of boiler had been a very great failure.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Dec. 7 the committee on nominations reported the following nominations for officers for 1893: President, Robert Moore; Vice-President, B. L. Crosby; Secretary, Arthur Thacher; Treasurer, Charles W. Melcher; Librarian, R. E. McMath; Directors, J. B. Johnson and Geo. H. Pegram; Members of Board Managers, J. B. Johnson and J. A. Baird.

Mr. J. B. Arnold read a paper on "The City Electric Railway Power Sation of Little Rock, Ark., and Its Record." The road was constructed in 131 days, including 32 days lost in Sundays and on account of rainy weather, or making 99 actual working days. During this time the entire system of about 20 miles of road was either taken up and new rails and ties laid or the track narrowed from broad to standard gage. At the power station there were 1,000 cu. yds. of solid slate excavated, over 1,000,000 brick laid, 333,000 ft. of lumber erected on the structure and 1,000 HP. of engines, boilers and condensing machinery put in place during this period. At certain seasons of the year the river water is exceptionally bad and special filters are necessary.

Some of the special features of the power house are: 1, the general idea of the building on a hillside; 2, the utilization of a short story for a pit room under all the cars; 3, providing for a washing pit under each track; 4, placing the line shafting on top of the partition walls; 5, the location of the car barn on top of the power house; 6, the placing of a summer theatre on top of the structure; 7, inclining the tracks for convenience in case of fire. A number of tables showing the cost of fuel and power used were exhibited and the tables showed a very low cost for power.

Prof. J. B. Johnson's paper on "The Bearing Resistance of Metallic Rollers as Determined by Experiment" was read by title.

Arthur Thacher, Secy

COMING TECHNICAL MEETINGS.

NEW YORK RAILROAD CLUB.
Dec. 15. Secy., H. G. Prout, 73 Broadway, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
Dec. 15. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Dec. 15. Secy., C. F. Franson, Portland Block.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Dec. 16. 201 Washington Build ng.
SWEDISH ENGINEERS' CLUB.
Dec. 17. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago Secy., John Erl son.
ENGINEERS' CLUB OF PHILADELPHIA.
Dec 17. 1122 Girard St. Secy., L. F. Rondinella.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Dec. 20. "Water Purification's." Secy., R. H. Clark, Pittsburg.
WESTERN RAILWAY CLUB.
Dec. 20. Rookery Building, Chicago. Secy., W. H. Marshall.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Dec. 21. "Base Line Measurements with the Steel Tape," Prof. A. E. Burton. Secy., S. E. Tinkham, 36 Broomfield St.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Dec. 21. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
Dec. 21. Secy., Arthur Thacher, Odd Fellows' Building.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Dec. 23. Secy., C. H. McLeod, Montreal, P. Q.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Jan. 2. Secy., C. L. Annan, City Engineer's Office.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Jan. 3. Secy., Chas. S. Howe, Case School
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Jan. 3. Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
Jan. 4. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Jan. 6. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Jan. 6. Secy., O. Von Geldern, 719 Market St., San Francisco.
NORTHWEST RAILROAD CLUB.
Jan. 7. Union Station, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Jan. 7. Secy., F. D. Jones, Helena.
WISCONSIN POLYTECHNIC SOCIETY.
Jan. 9. Secy., M. F. Schinke, City Hall.
ENGINEERS' CLUB OF KANSAS CITY.
Jan. 9. Secy., Waterman Stone, Baird Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
Jan. 10. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
DENVER SOCIETY OF ENGINEERS AND ARCHITECTS.
Jan. 10. Secy., Geo. H. Angell, 35 Jabson Block.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
Jan. 10. Secy., Parker N. Black, Capitol Block.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Jan. 11. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Jan. 11. Secy., F. M. Curtis, O. C. R. R., Boston.
ENGINEERS' CLUB OF MINNEAPOLIS.
Jan. 12. Secy., F. W. Cappelen, 1028 Hennepin Ave.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Jan. 12. Secy., Edward Mead, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
Jan. 12. Secy., O. H. Landreth, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Jan. 13. Secy., D. W. Meeker, St. Paul.
MICHIGAN ENGINEERING SOCIETY.
Jan. 17, 18, 19. Annual meeting at Lansing, Mich. Secy F. Hodgman, Climax, Mich.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 19. Atlanta, Ga. Secy., F. A. Charlot, Macon, Ga.
CENTRAL RAILWAY CLUB.
Jan. 25. S. W. Spear, E. Buffalo, N. Y., Iron Works.
AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 21, etc. Annual meeting, Montreal, Que. Secy., R. W. Raymond, 6 Barling Slip, New York, N. Y.

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AND
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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

In order to afford ample time for all the engineering schools which need and desire to do so, to correct the figures in regard to their distribution of students' time given in our issue of Dec. 1, we postpone the construction of the diagram there referred to for another issue, and any corrections sent immediately after the receipt of this issue will be included in that diagram.

We again request the officers of all engineering schools to see that they are properly represented in the figures referred to.

Blue printing can be done in cloudy weather nearly as well as on a bright day by the use of oxalic acid in the solution. Fuller particulars are given on another page of this issue, and are referred to here merely that none of our readers may miss what will prove a great convenience to many, especially during the winter months.

We know from letters and by word of mouth that some engineers for whom we feel great respect have been disposed to think we were hypercritical in discussing "The Ethics of Consulting Practice" in our issues of Nov. 10 and Nov. 24. That we were not so, however, or at least that there is much difference in theory and in practice between different engineers who stand high in the profession, is proved in a very apt way by a correspondence which has appeared since these articles were written, and which we reprint in another column as our justification for raising the question, and as a proof that some discussion of it was and is needed. We express no opinion upon the interior merits of this case. We have not even formed any definite opinion. No such opinion is needed to form an opinion on the questions of "ethics" at issue since these concern only the outward forms of courtesy of professional relations, not the interior merits of technical or personal disputes. Here are two eminent engineers who evidently differ widely on such questions. One of them, Mr. Frizell, is generally known as one of the oldest and soundest of our hydraulic engineers. The other, Mr. Fanning, enjoys an equally high standing in the profession, as is evidenced by the fact that he has been recently nominated as a director of the American Society of Civil Engineers; and he is even more widely known by the general public. If two such men can differ so radically on questions of conduct, how can it be expected that younger engineers will know how to shape their course safely?

How to light shop and factory buildings is a problem which receives great attention nowadays, and receives many different solutions. In another part of this issue a description is given of the roof on the shops of the Straight Line Engine Co., of Syracuse, N. Y., which is of the "weaving shed," or "ridge-and furrow" type, a roof which is in common use in England but is practically unknown in this country. The reason for the use of this roof in England is that it gives a better and ampler light than any other arrangement in use, which is a matter of great importance under the leaden skies of England. While the proportion of bright days is larger in this country, there are many days when even the best lit shops have too little light. The objection to the ridge-and-furrow roof in this country is the heavy snowfall, and the difficulty of drainage; but this is claimed to have been met at the Straight Line Engine Works by the system of gutters and conductors elsewhere illustrated. If this is the case, this method of construction should be carefully considered by all engaged in the design of buildings for manufacturing purposes. It is probably not quite so easy to ventilate a building so constructed as to ventilate with the common monitor roof; but with swinging sash in the roof lights, fair ventilation should be possible; and so many shops nowadays have the blower system of heating and ventilating that window ventilation is not so important as formerly.

In this connection it may be appropriately said that two frequent causes for bad lighting in shop buildings are dirt on the glass and dark interior walls. With the ordinary system of shop lighting, —windows in the side walls with small panes of glass,—cleaning the inside of the windows is difficult and takes place at long intervals if it is not entirely neglected. The consequence is that dust and smoke accumulate on the glass until its light transmitting capacity is greatly reduced. But with the glass concentrated as it is in the ridge-and-furrow roof, cleaning can be done easily and systematically.

Defective shop lighting, however, is due more to a lack of general illumination than to an insufficient quantity of light admitted. As shown by a paper in our issue of Nov. 24, the reflection from white walls and ceilings actually doubles the total illumination in a room. Thus by the application of a few pails of whitewash, a gain in the lighting can be produced equal to the gain by doubling the window area; the distributed light reflected from white walls and ceiling, moreover, is just what is needed to light the spaces behind machines which cannot receive direct light from the windows. One occasionally sees in shop buildings recently erected evidence of an appreciation of these facts; but it is far commoner to see walls and ceilings as they were left by the carpenter or bricklayer; and as for the great multitude of shop buildings, which have been in service for a dozen years or more, their grimy walls are nearly as effective absorbents of light as if they were painted black.

It is a noticeable fact that the best success has been attained in the construction of ground floors for machine shops when good practice in street paving has been imitated. The Straight Line Engine shops, above referred to, are floored with what is practically a Telford paving of extra thickness on which a two-course wooden floor is laid. Wood block paving, and asphalt paving, both sheet and block, laid exactly as in street work, are all in successful use. The foundation of concrete which is now a recognized essential to good street paving work, is being largely used as the base of shop floors, and if laid on well rolled earth properly drained allows ordinary machines to be located wherever convenient on the floor without special foundations.

Where wooden floors must be laid, trouble is generally experienced from decay. Moisture is apt to accumulate to some extent on the underside of the floor; and if it does not and the wood is not perfectly dry, dry rot will occur, the air being excluded. In this connection Mr. C. J. H. Woodbury calls attention to the value of air slaked lime as a preservative of such floors. Its antiseptic qualities are well known, and experience shows that wood when laid in contact with dry lime will last indefinitely.

The extension of the export trade of this country and especially the increase in the exports of manufactured goods is heartily favored by practically all intelligent Americans, whatever their political affiliations. A main point of difference between the two great political parties has been whether it were wiser to secure this extension by increasing our general restrictions on import trade and bargaining with different countries by reciprocity treaties to secure special advantages for certain American goods, or on the other hand to lessen our tariff restrictions, especially on raw materials, and thus aid our manufacturers in competing with those of other nations in the world's markets. The latter policy is the one which is to be in force, by virtue of the result in the recent election; and it is well for American manufacturers to consider in what lines an export trade can be first cultivated with best prospects of success.

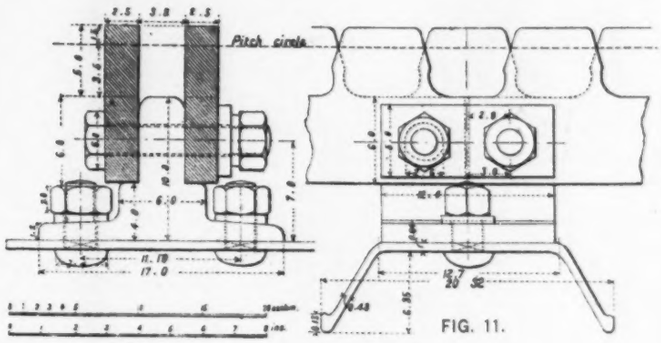
American supremacy in the manufacture of such articles as sewing machines, small arms, and agricultural machinery has long been acknowledged. But at the present day we may fairly lay claim to superiority in a much wider circle of manufacturers. In many lines of heavy machinery, for example, where we were formerly at a disadvantage on account of the high price of our raw material, we may now challenge any nation to a competition on equal terms, for the disparity in cost of materials is now very small, and bids fair soon entirely to disappear. The experience of our manufacturers in supplying the demands of their own country has developed types of machinery which can show better efficiency at less cost than that made anywhere else in the world.

It is not necessary to make the stock claim for Yankee ingenuity to account for this. American locomotives and cars, for example, have reached their present stage of development largely because the country has about 3-7 of the railway mileage of the world, and an enormous proportion of long distance freight and passenger traffic. American bridge building practice has been developed through similar causes. American pumping engines have reached their present efficiency through the demands of over 2,000 public water supply systems, using water with a lavishness unknown abroad. In this connection we take pleasure in calling the attention of our readers to the advertisement in another column asking American proposals for high duty pumping machinery for the city of Osaka, Japan. A capacity of about 18,000,000 gallons is required with a duty of 100,000,000 ft.-lbs. per 1,000 lbs. of steam.

A recent example of American and British competition in bridge building for a South American railway is related elsewhere in this issue; and it is shown that American firms can fill an order in one-fourth the time required by their competitors across the water and at a less cost per pound for the finished structure. Instances like these give much encouragement to those who look with confidence for the rapid growth in favor of American manufactures, especially in the Spanish-American countries. Another competition in which American manufacturers ought to stand good chances of success is the electric lighting plant to be built for the city of Santiago, Chili. Proposals are to be received by the mayor of that city up to March 1, 1893. American electric lighting companies have already done much in cultivating export trade; and notwithstanding certain acknowledged influences which strongly favor English manufacturers in Chili, the merits of American apparatus and machinery ought to give American firms a fair chance of securing the contract. It may well be said here, that probable revision of the tariff should greatly help our electrical export trade. The duty on copper is one of the least defensible provisions in the present tariff, and so large a proportion of the cost of an electric plant consists of the cost of the copper that the removal of the duty ought to give a noticeable impulse to American electrical enterprises.

THE NICARAGUA CANAL STATUS.

Whatever else may be thought about the Nicaragua Canal project it cannot be denied that it is getting to occupy a large share of public attention if the usual signs of such attention are not deceptive. While much may be accomplished in behalf of any such project by judicious effort behind the scenes, no amount of such effort could have produced so many concurrent signs of a



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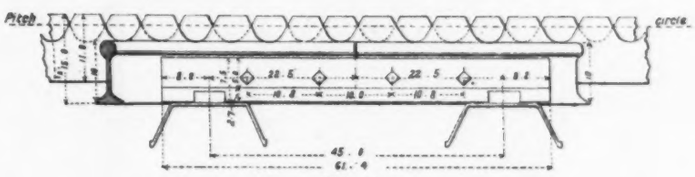

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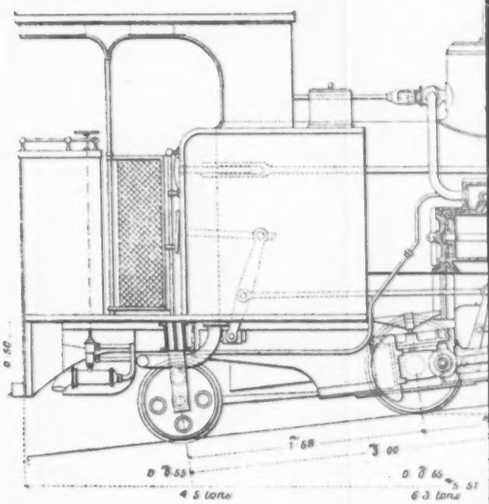

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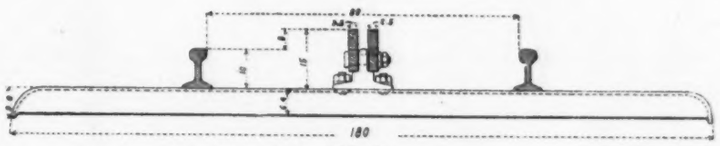

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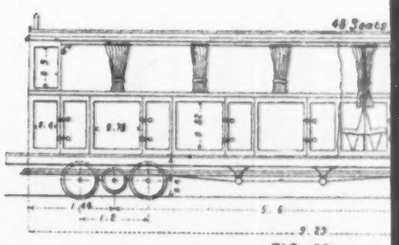

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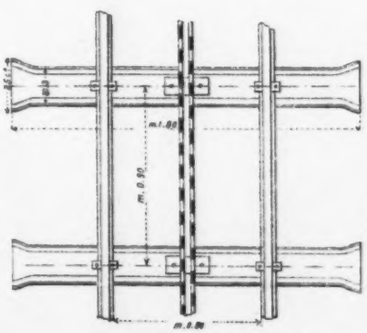

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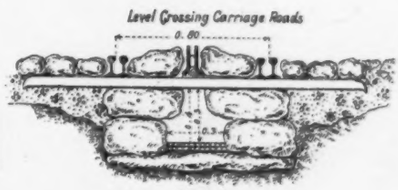

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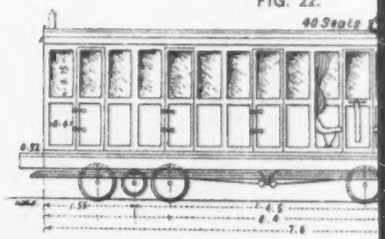

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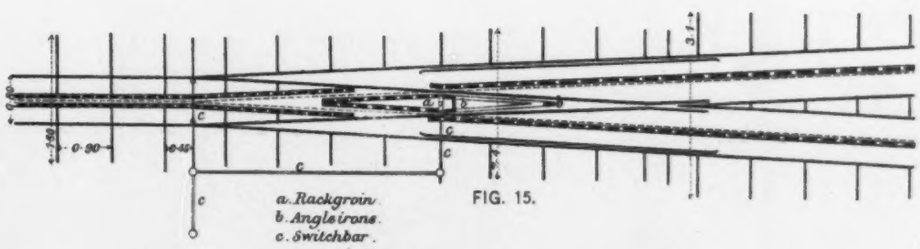

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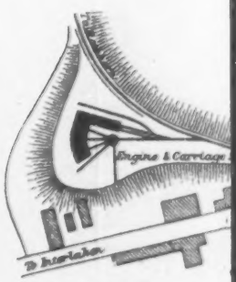

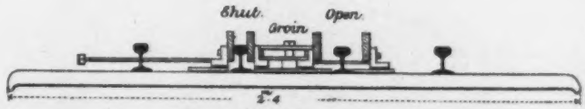

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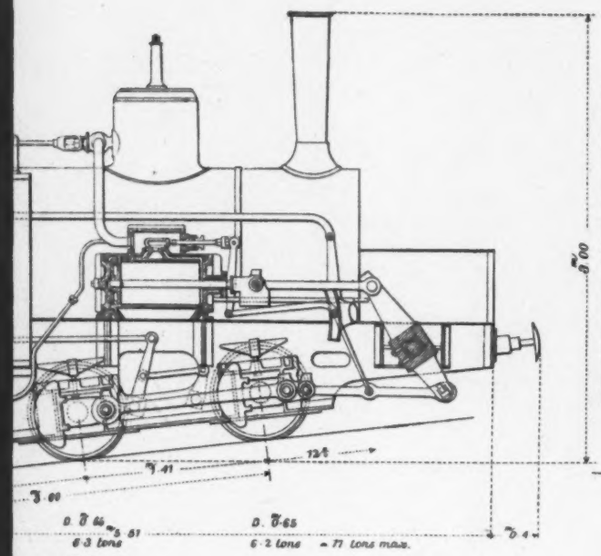

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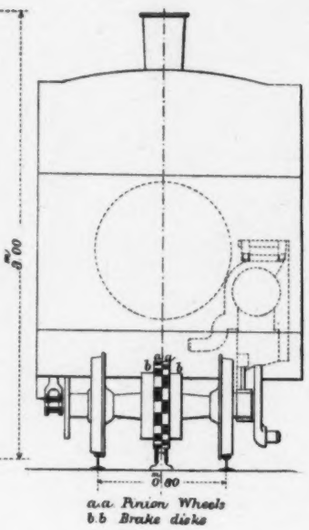

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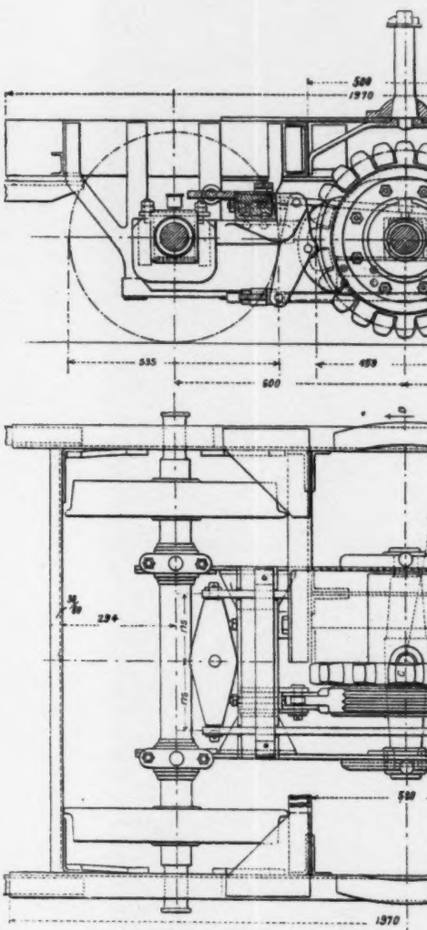

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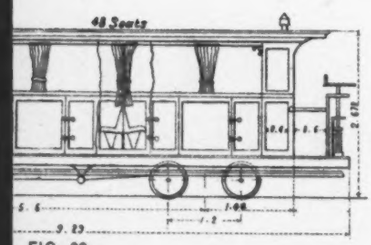

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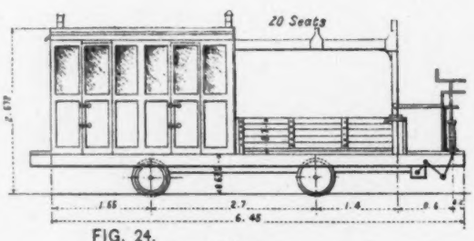

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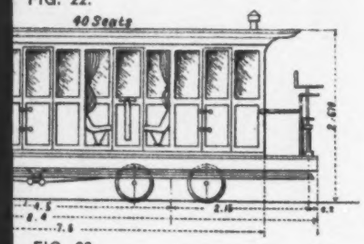

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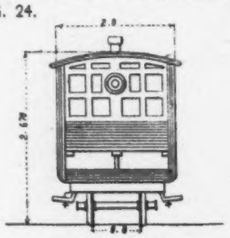

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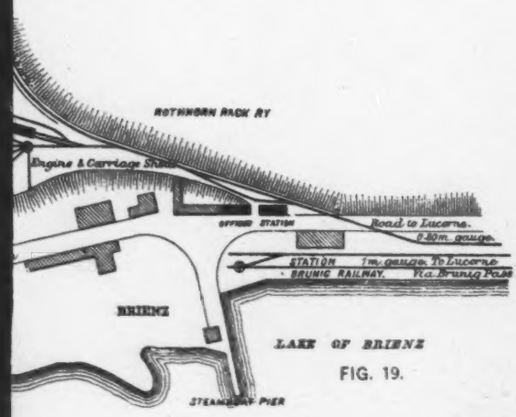

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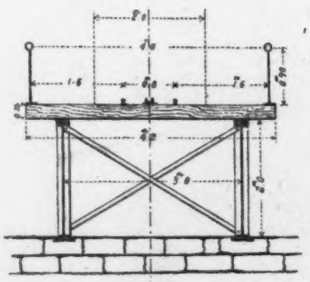

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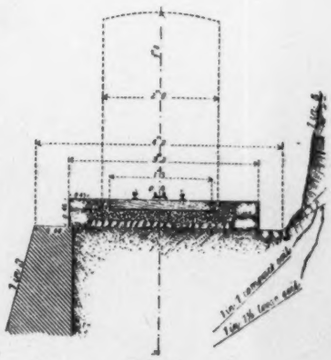
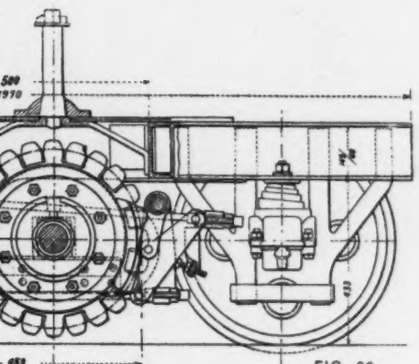


FIG. 6

ENZ AND ROTHHORN RACK RAILWAY, SWITZERLAND.



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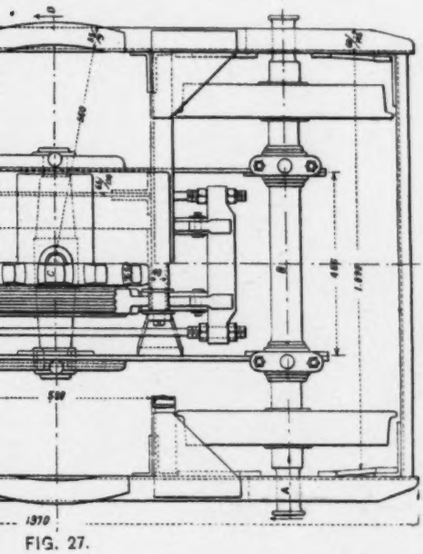

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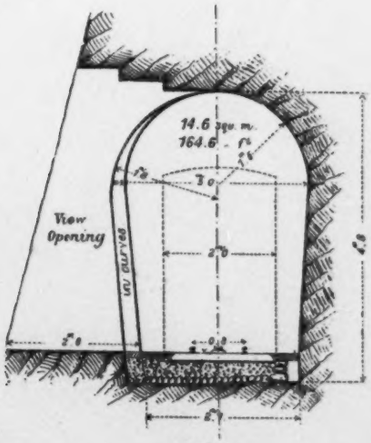


FIG. 7.

CHAS. HART & SONS, LITH, 95 VESEY ST., N. Y.

deep public interest unless such interest existed and was growing stronger.

To enumerate only a few of these signs, both of the great parties put emphatic planks into their platforms in favor of national supervisory aid to the canal. Both candidates for the presidency took pains to express approval of this plank in their respective letters of acceptance. City Boards of Trade without number have within the past year (in addition to former action) passed resolutions of like purport, as have a large proportion, if not a majority, of the state conventions of both parties. Still more recently a great convention has been held in New Orleans especially devoted to consideration of this project; and within the past week the outgoing President, in his annual message to Congress, has made the following emphatic recommendation:

> I repeat with great earnestness the recommendation which I have made in several previous messages that prompt and adequate support be given to the American company engaged in the construction of the Nicaragua Ship Canal. It is impossible to overstate the value from every standpoint of this great enterprise, and I hope that there may be time, even in this Congress, to give to it an impetus that will insure the early completion of the canal and secure to the United States its proper relation to it when completed.

This had been preceded in the Secretary of the Interior's report by an extended and detailed summary of the condition of the work, closing with the opinion that the work was of the utmost importance for the welfare of the country in either peace or war, and should have most favorable recognition and support from Congress.

As for the latter body, it is slow to move, as it ought to be, in matters putting at risk from $70,000,000 to $100,000,000, or conceivably even more, of the people's money. Many of the members of the present Congress, and still more of the coming one, have not even now studied the matter so carefully as to be prepared to vote at once for governmental endorsement of the bonds of the company, we may well believe. But those members of either house who have studied it appear to be all but unanimous in its favor, as was strikingly illustrated by the unanimous favorable report from the Senate Committee on Foreign Relations on a bill to guarantee the company's bonds, submitted last winter (Eng. News, Jan. 17, Feb. 7, 1891). Political antagonisms then as now ran high. This particular committee is apt to include the oldest and most obstinate members of both parties. It is a large committee, having nine members. That such a committee should be able to agree unanimously on any important measure whatsoever, still more on one assuming such a large financial risk for any purpose, and still more for such an exceptional purpose as a public work in a foreign country, is a most exceptional event, and surely indicates a strong feeling in favor of such action, and very little against it.

It is now reported that this same committee has unanimously decided this week to report a new bill substantially the same as the last one but with minor modifications, early consideration of which will be urged with expectation that it will pass at this session. This hope seems not unreasonable, for the measure has never been, nor been treated as, a party measure. In addition to the patriotic motives which should influence both parties alike, the Republicans may well feel that it would be good party policy to pass the bill under a Republican administration; while its Democratic friends may well feel that now is the best time to pass it to avoid indefinite delay, as the time of the next Congress is likely to be pretty well occupied with discussion of tariff measures and other questions incident to change of the party in power.

Before these words reach the reader the new bill may also be before him, and therefore it would be a waste of time to review again the terms of the old bill, which were fully given in our issue of Feb. 7. We will only repeat, therefore, that it was in effect a mere endorsement of the company's securities, leaving the company itself to manage the work and earn, if it could, a strictly limited but considerable profit by managing it successfully and completing it within the estimates. But the government itself would receive the lion's share of the profits of such good management in return for its endorsement, and also obtained full power to control the management, and especially the rates of toll, in the public interest. On the other hand in case the company should fail to build the canal within the estimates, and should also fail to raise the further sum of money needed to complete it,—a contingency scarcely supposible, unless the deficiency were of great magnitude—it would devolve upon the government to finish the work, as it would then have to assume it or lose its previous investment.

But supposing it did, the people would lose nothing if the canal is really worth building, and the argument in favor of building it or enabling it to be built under American auspices is so immensely strong that we cannot but feel there will be early and almost unanimous action to that effect. In the first place, although the work is physically in a foreign country it is functionally an interior means of cheap communication between our Atlantic and Pacific domains, placed in the only locality where it is possible to place it. It is therefore as proper a subject for national aid as the early Pacific Railways for reasons of internal policy, and much more so from reasons of external policy, because being within the jurisdiction of a weak foreign state, we can be quite sure that if we do not build it some one else will. It will not remain unbuilt awaiting our convenience for an indefinite period, as it would do perforce if within our formal jurisdiction.

A second strong reason why the work should be aided by a government guarantee is that it would mean a great difference in necessary rates, all the difference between a 3% basis and a 10 to 25% basis. The mere act of guarantee will ensure to the company an abundance of money at 3% or less without any trouble or delay for negotiation; without it, especially after the Panama fiasco, it is idle to expect that private individuals will risk so vast a sum in however sound an enterprise prima facie, unless they see or think they see 15 to 25% per year in stock and bonds together. To private individuals it is necessarily a highly speculative investment, though to the government, which can afford to wait, and not at all inconvenienced by locking up $100,000,000 for a term of years, nor even by its total loss if the general public gains more than that sum, it is not at all speculative. Now it is the general law of all such works of communication that the total profit of the investors, however large, is only a small fraction of that which accrues indirectly to the public. Therefore, when the government backs such an enterprise, it stands in a dual relation to it, it has a double chance for profit. In the first place, it is as likely to reap direct profit as any other investor, if the company proves a profitable one as such. In the second place, even if the company proper never earns a dollar, it represents and acts for those to whom all the indirect benefits of its construction accrue.

Nevertheless, if the enterprise were such that private capital could reasonably be expected to construct and manage it properly, all our national traditions would be against governmental interference; but when its magnitude and risks to individuals are such that the work may not be built at all, or only after long delay and with enormous capitalization held by foreigners, how strong is the argument that the government should back the enterprise, and thus without any investment, except in one contingency, secure at once cheap construction, early construction, national control and low tolls for all time; such, for example, as will earn a $3,000,000 interest charge instead of a possible $15,000,000 to $20,000,000 for interest charge and dividends on stock combined, for the latter might be pushed up to any figure.

The contingency referred to is solely that the work may finally prove to be much more costly than has been expected; so far exceeding all present estimates and allowances that the government will be compelled to assume and complete the enterprise in its own name. But that, should it occur, would be strong presumptive evidence. that the work was one unsuited for private enterprise from the beginning, and thus that the government should have taken hold of it in the beginning as the only way in which a great and needed public work could be carried out. Grant that the government may finally have to assume the enterprise, and spend $300,000,000 to complete it, instead of the $100,000,000 which is the present outside estimate. Even then, the tolls will not need to net more than $9,000,000 per year to keep the government whole, or a much less sum than a private company without government backing will require to meet the fixed changes on $100,000,000 of actual cash expenditures. By simply guaranteeing the interest of such a company's bonds the government removes from its path by far the most serious cause for total failure or excessive cost. Every one knows that the raising of money at the right time and in the amount needed is the most serious and most dreaded risk of great private enterprises, and the most frequent cause for their failure. Is it not better thus to smooth a private company's path in the beginning, and so secure the advantages both of public control and of private management, than to leave such a company to struggle on unaided, and either succeed and exact enormous profits or fail (with the ruin of many individuals) and have the government compelled to take it up after all or leave the work unfinished?

But we have no belief that the cost will be thus excessive. On the contrary, the third reason why the government should, in our judgment, extend to the present company the proposed guarantee of its securities, is that they may have a fair chance to grapple with the technical an constructive difficulties only, and thus to show to the world if they can, and we believe they will, that such enterprises do not necessarily involve enormous excesses over the original estimates when properly planned and properly managed. The prestige thus gained would be of immense advantage to Americans in competing for the construction of great public enterprises all over the world, and it would also benefit the whole civilized world by removing the cloud which the Panama fiasco, and the excessive cost of the Suez Canal, have thrown over these vast enterprises, of which there are a number of others which still need doing.

This cloud is wholly undeserved. The apparent precedents have no real pertinence, since they arose solely from causes which have been removed from the Nicaragua project, viz., the absence of all basis of fact and all engineering supervision over the alleged estimates put forth in the beginning, combined with a corrupt, reckless and untechnical management. Lesseps was not an engineer. His wild and crazy claims (for such they were and such we pronounced them years before the final collapse), were based upon nothing but his hopes, when he announced that he was going to build a sea-level canal, and what it would cost. Not even a center line survey had been made over the route when work was started, nor for months nor years afterwards. Not even a project had been made, nor has been made to this day, for the largest and most dubious single feature of the work—the dam to control the Chagres River. From the very beginning the best American engineers declared their conviction that the sea level canal could never be built, as our columns will bear witness.

On the other hand, the Nicaragua Canal has been surveyed, cross-sectioned, "bored" and test-pitted throughout with the greatest care. The precise kind and quantity of material to be dealt with at each point has been determined with more care and completeness than on any other public work of any kind (and of any magnitude) that we know of. From this material, which is accessible to any one at the company's office, the chief engineer prepared a detail estimate aggregating $65,084,176. This estimate, with all the data on which it was based, was submitted to a board of five consulting engineers with instructions to go over it in detail and report independently their own conclusions. Their report was rendered some months later, in 1889, but has only recently been made public. It is given in full in another column. They saw fit to increase Mr. Menocal's estimate from $65,084,176, including 25% for engineering and contingencies, to $87,790,570, including 31⅓% for engineering and contingencies. But how did they reach this conclusion? As stated in their report, by the short and simple process of not even considering whether any item which seemed excessive might not properly be reduced, but by increasing any item which seemed possibly inadequate until it seemed certainly enough. Not only so, but we are in a position to state explicitly, from positive knowledge, that whenever any single member of the board expressed doubt as to the allowance for any single item being sufficient, it was by general agreement increased until he felt satisfied that the

amount was sufficient; so that each several item in the estimate is in fact the highest sum which any member of the board thought should be allotted to that item. An estimate revised in this fashion (which yet was a prudent and proper one under the circumstances) naturally grows apace, and it is much to the credit of the chief engineer that the final result was no more above his estimate than it was.

Between an enterprise studied in this fashion and one vouched for only by wild predictions of M. Lesseps, based on nothing but his hopes, if even on that, there is no real comparison. Moreover, as to the sufficiency of one item of the Nicaragua Canal estimate, the first and perhaps the most doubtful in the list, and the only one on which construction has progressed far enough to make any check possible, we have some definite evidence. For the railway and telegraph line from the Gulf inland Mr. Menocal estimated $731,100; the board of engineers increased this to $1,110,000; the work is now more than half done, and at the rate of but little more than $400,000 for the entire work!

This is surely pretty good evidence, so far as it goes, that if the great difficulty of raising such a vast sum of money on reasonable terms can be overcome, the total cost of the canal complete will come within $88,000,000 at least, it not within $65,000,000. We feel a strong conviction that it will do so, to the immense advantage of the world in general and the United States in particular. We earnestly hope and believe that Congress will take the same view of the matter.

SOME DEFECTS OF ELECTRIC TRAVELING CRANES.

The traveling bridge crane, without which the equipment of a modern manufactory handling heavy materials is not considered complete, has come into use so recently and has been adopted so rapidly that it would be idle to deny that it has met and filled an important want. Its advantages over the old fashioned jib cranes, which no more than ten years ago were in well-nigh universal use, are in the application of power to the work of hoisting (the old jib cranes being generally worked by hand), in the saving of the large amount of floor space which the jib cranes occupied, and in the ease, rapidity and convenience with which the entire area of the shop can be reached, and that without disturbance of any operations on the shop floor.

These advantages are so apparent that it is small wonder bridge cranes have come into use so rapidly. But in mechanics as in society, things which are in the fashion are very apt to be overdone. Because blue happens to be all the rage, people are apt to wear it whose complexions would be better suited by some other color; and because a great many establishments find it profitable to replace jib cranes with bridge cranes, it does not follow that every manufacturer will find the power-driven bridge crane the most economical method of handling materials in his shop.

The defects of the bridge crane are that it can be used only for one thing at a time, and the larger the shop, the greater is the amount of time wasted in travel of the bridge and the bridge trolley.

If the crane is not kept busy all the time, workmen are apt to economize their muscle by using it to move weights which could be more quickly and cheaply moved by hand. But if there is work enough to keep the crane busy any considerable part of the time, there will be more or less time lost in waiting for its services. Again, notwithstanding the high speeds of modern bridge cranes, the multiplicity of movements take considerable time. The advantage of being able to reach any point on the floor area covered is in many establishments of very small importance, practically all of the crane's work being between certain definite points. Finally the question of danger is one of some importance. The crane and its machinery can be designed to carry their maximum load with perfect safety; but no such security is possible with the wrappings of chain or rope by which the load is secured; a kink or twist in a chain or a frayed place or loose knot in a rope may let a heavy weight drop on some unfortunate workman or some costly machine tool.

Much more might be said, but this is perhaps enough to show that the traveling bridge crane, useful and valuable as it is, is not necessarily the best possible solution of the transportation problem in each and every establishment. Because of the great popularity of the bridge crane the fact should not be overlooked that many other excellent systems of hoisting and carrying are now available and should be given consideration in planning a shop equipment. A well planned system of shop tramways, with a system of pneumatic hoists, will do a great deal of work more cheaply than a large crane. Single overhead trolleys, "walking" jib cranes, and stationary jib cranes worked by hydraulic power will move work over fixed routes with astonishing celerity.

Probably the traveling bridge crane owes a considerable part of its popularity to the use of the electric motor to operate it. At any rate a great increase in the popularity of bridge cranes has occurred since electricity was applied to their operation. The advantages of the electric motor for this purpose over a steam motor with its accompanying noise, dirt and clouds of vapor is beyond question. But notwithstanding the great popularity of the electric motor it is not wholly certain that it is the best possible device for operating bridge cranes of every class. Cranes driven by square shafts, by running ropes and by hydraulic power are in use and give good satisfaction; and in some points are claimed to be superior to the electric system.

Just what the relative merits of these several classes of cranes are, is a subject worth investigation, and one on which little information is to be found in technical literature. At the recent meeting of the American Society of Mechanical Engineers a paper was presented describing recent tests on the electric bridge crane of 120 tons capacity at the Watervliet Arsenal. The author had made exhaustive tests which showed that the mechanical work performed by the crane represented from 20% to 60% of the electrical energy absorbed by its motor.

This information is all very well in its way; but what is wanted in order to compare the relative cost of the power used by electric and other cranes is the actual amount of steam used in the engine which drives the dynamo furnishing current to the crane. The works are very few where an electric crane can take its current from the mains of an electric lighting company, and we believe the great bulk of electric cranes now in use are operated by an independent circuit, current in which is maintained by a dynamo driven by a separate engine. This circuit must be maintained at all times during working hours, ready for the use of the crane motor, for there is no storage of the electric energy. A bridge crane is a tool which is used only as it is needed, and during all the time it is at rest the dynamo engine goes on using at least enough steam to keep it up to speed.

Of course where the electric current from the same circuit is also used for driving motors, perhaps on other cranes in the same establishment, the waste of power is not so great, though it will still be considerable; but at present these conditions obtain in few works. The typical plant consists of engine, dynamo, and motor or motors on the crane as stated. In short, then, the electric crane tends to use power wastefully on account of its lack of storage.

Whether the ability to store power which a hydraulic plant possesses can make its total economy greater than that of the electric motor system is something which only careful tests can determine. Nor will anyone maintain that the power used by a crane is an important matter compared with convenience, safety, and rapidity of movement. So far as it is important, however, the defects as well as the advantages of each system should have fair consideration.

The question of first cost in many plants will be considered of more importance than the cost of motive power; and here the running rope or square shaft system, especially the former, deserves to be carefully compared with the electric system. The running rope system is simple, cheap and economical of power, and deserves to be more used for cranes of moderate capacity. The square shaft system is in use on cranes of considerable capacity but is objected to by some on the score of noise and rapid wear. Considering that the electric system has to be debited with the cost of a steam engine and dynamo capable of furnishing a current up to the crane's capacity, the chances seem very good that either the square shaft or the rope system could show a considerably smaller first cost. With the hydraulic system the balance is more doubtful.

Of course there are many other considerations, such as reliability, cost of repairs, attendance required, speed obtainable, etc., which must enter into any thorough comparison of the relative merits of different motive powers for bridge cranes. The trouble is that at present such problems as this are given slight attention. It is too often considered that an electric bridge crane must be the best possible solution of the problem, since its use is now so general, whereas more careful study might lead to a different solution of the problem.

The heavy weights which are handled and the areas over which some of our modern manufactories spread, make the problem of internal transportation one of ever increasing importance. Time devoted to its careful study with a view to securing the system best adopted to the special circumstances of the case can hardly fail to be time well spent.

The disposal of the sewage of Paris is a live problem just now for the French Government and the French engineers. Two years ago a new law went into effect compelling all builders of new houses to connect directly with the city sewers, and in this interval 7,000 such connections have been made, and about 2,000 new apartment houses are erected each year. Previous to the issue of this law all house sewage was gathered into cesspools, emptied about once a month, and the sewage farms at St. Denis and Gennevilliers could readily dispose of all sewage that came to them. With the new house connections about 300,000 cu. meters of offensive matter daily finds its way untreated into the Seine below Paris. Sixty communes between Paris and Rouen now protest against this pollution of the river. Paris itself suffers; for pending the completion of the new water supply works many of its citizens are compelled to use Seine water for household purposes in the summer. One remedy suggested and now before the House of Deputies in the form of a bill is a project for a sewage canal from Paris to the sea.

The proposed Danube and Oder canal is favorably considered in a report sent in to the Ministry of Commerce by the special Austro-Hungarian commission appointed to study the question. The main object is to create a cheap water-way between Vienna and Oderberg, where it would join the German canal system. The mouth of the proposed canal is to be at Vienna, and it is to take its course via lower Austria to Oderberg, running into the Oder. This water route, which traverses the rich coal district of Moravia and Silesia, would be of great importance to Vienna, as it would admit of cheap coal transport, and thus, is is said, render it possible for the capital to become an important manufacturing center like Berlin, which city, although situated a long way from the coal-producing districts, gets its coal supply cheap from Prussian Silesia by way of the rivers Oder and Spree. The projected canal will also place Vienna in communication with the textile industries of Moravia and Silesia. For these reasons the provincial diets of Lower Austria, Moravia, and Silesia declared their readiness to vote subsidies for the enterprise some years ago. In connection with the main water-way, it is suggested that a lateral canal, taking the direction of Bohemia and ending in the Elbe, should be constructed, and another lateral canal would leave the main system at Oderberg and run toward the Vistula, and thus place Cracow and Galicia in possession of cheap communication with the center of the monarchy. The scheme was initiated some years ago and postponed in consequence of the heavy expense it would entail, but the institution of architects and engineers of lower Austria and the Danube association have now revived it. The reasons that have prompted them to do so are: 1, to meet the increased competition with Germany, resulting from the new commercial treaties, by opening a convenient water-way and junction with the German canal system, the freight on the existing Austrian canals being 10% higher than in Germany; 2, in anticipation of the projected opening of a Danube harbor on the Vienna-Danube Canal; 3, to provide against the disadvantages resulting from the technical impossibility of reducing the tariffs on the railway covering the route of the proposed canal, which belongs to a private company and cannot afford to take such low rates as the State railways.

LETTERS TO THE EDITOR.

FIRE TEST OF A FIREPROOF CHICAGO BUILDING.

Sir: I have read your report on the fireproof material used in the Chicago building with interest, and will thank you to let me know what kind of terra cotta was used therein, whether porous or hard tile. In the Denver tests, the porous material did not fail under a somewhat similar test to what the material in the Chicago building was subjected to.

Yours very truly, M. J. Butler, C. E.

Deseronto, Ont., Dec. 5, 1892.

(The reports sent us gave no name to the kind of fireproofing material used. It does not appear that the material failed in itself, as where it remained in place the iron was uninjured, but the trouble was due to faulty placing and fastening so that the material fell off and left the iron exposed.—Ed.)

THE SANTOS & JUNDIAHY RY., BRAZIL.

Sir: Referring to your article on "The Otis Elevating Cable Railway," in your issue of Aug. 18, 1892, I notice that you omit to include among the railways operated by the cable system, one which is, perhaps, the most important of all, namely, the Santos & Jundiahy Ry., of Brazil. The "Serra" division, the portion of the line operated by the cable system, is 8,000 meters (5 miles) in length, and in that distance there is a rise of 778 meters (2,551.84 ft.). The division is divided into four sections of nearly equal length and rise, each operated by a battery of four 100-HP. boilers, and four engines with a combined capacity of 200-HP.

The average grade is 9.725%, the maximum being 11%; the shortest radius of curvature is 603 meters (about 2,000 ft.). The track is 1.6 meters gage. The rope is of steel, 1 7-16 ins. in diameter. The entire line is operated at a very handsome profit to the English company owning it. The work was begun in November, 1860, and the road was opened for traffic in 1867. The cost of the entire line, 139 meters in length, was £2,650,000. The Serra division was, of course, the most expensive, but I have not been able to obtain figures showing its cost. I passed over the line several times during the past year, and can testify to the solidity and permanence of the work.

New York, Dec. 3, 1892. Thos. J. Long.

THE FIRST QUADRUPLE EXPANSION ENGINE.

Sir: In your issue of Nov. 17, p. 470, you say in a note that, "the first quadruple expansion engine built in England for stationary service has just been turned out," etc. Kindly permit me to ask your perusal of the following extract from the "Proceedings of the Institution of Mechanical Engineers," England (Manchester meeting), July, 1875; p. 307, under the head of Excursions:

July 29, at Hyde Junction, Messrs Adamsons' Engineering Works were visited. . . . . In the two adjacent cotton mills of the Newton Moor Cotton Spinning Co. were seen the triple and quadruple horizontal compound engines constructed by Messrs. Adamson for driving the whole of the machinery. The first, erected in 1862, has three cylinders on the same piston rod, the diameters being 16, 22 and 38 ins., and the stroke 6 ft.; the steam enters the first cylinder at a pressure of 80 lbs. per sq. in., and the third cylinder at about atmospheric pressure; the engine makes 33 revs. per minute, and a second similar engine is coupled at right angles, the pair showing about 670 I. HP. The other engine, erected in 1874, and driving about 550 I. HP., has four cylinders in two pairs, coupled at right angles; two cylinders are on each piston-rod; the first two 17 and 22½ ins. diameter, and the second two 30¼ and 42 ins.; the stroke is 5 ft., and the engine makes 43 revs. per minute. The initial steam pressure is 96 lbs. per sq. in. in the first cylinder and about 1 lb. in the last, the vacuum in this cylinder being 12 lbs. per sq. in. The steam is superheated in its passage from the second to the third, and from the third to the fourth cylinder by means of a casing filled with fresh boiler steam.

The writer would add that as a member of the Institution he was present at the excursion referred to.

Yours truly, Thomas Hedley.

Portland, Ore., Dec. 2, 1892.

(We based our original statement quoted above upon the authority of our London contemporary "Engineering," which in describing the engine built by Musgrave & Sons in a recent issue, said:

This engine is remarkable as being an application of the principle of quadruple compounding to land engines. For four or five years quadruple expansion engines have been fitted to steamers by several firms of marine engineers, and the economical result attained have suggested to John Musgrave & Sons the idea of applying this type for driving spinning machinery.

Our correspondent's correction is of much interest, as we venture to say that few engineers, either American or English, appreciate the fact that the system of expansion through four cylinders in succession is now nearly a score of years old in practical application. If any of our readers knows of a quadruple-expansion engine put into service prior to 1874, we hope he will make the fact known.—Ed.)

NOTES AND QUERIES.

A asks the following questions in regard to docks and piers: 1, Where the largest dock or pier was ever built on the Great Lakes? 2, What is the largest pier in the world? 3, Give the floor space of each.

L. Y. S.—The best machine for excavating rock under water by concussion is probably the Lobnitz dredge (Eng. News, Jan. 26, and Oct. 19, 1889; Sept. 8, 1892), manufactured by Lobnitz & Co., of Renfrew, Scotland, and now used on the enlargement of the Suez Canal.

"THE ETHICS OF CONSULTING PRACTICE."

In two recent articles we have had something to say on this subject. That there is need for something to be said, and to be done as well, so that engineers may know where they stand in such matters is illustrated by the following correspondence, giving both sides of a very recent case where there seems to be considerable difference of opinion btween the engineers concerned as to what the "Ethics of Consulting Practice" demand. As such, we give the correspondence verbatim, reprinting it from the last issue of our contemporary, the "Engineering Record:" The technical side only of this case was discussed by Mr. Frizell in a communication published in our issue of Sept. 29, 1892. As then stated, proofs of this article were sent in advance to Mr. Fanning, that he might reply in the same issue if he so desired; but so far he has not done so, so that only one side of the technical case has as yet been before our readers. The two sides of the "ethical" case are set forth in the correspondence as follows:

Sir: As a matter of professional and general interest, I wish to briefly state the essential facts and conditions of an important engineering enterprise which is vaguely familiar to many of your readers, and can be justly conceived of only upon an impartial presentation of facts. Most engineers know that extensive hydraulic works are under construction at Austin, Tex. They consist of a massive masonry dam with a maximum height of 70 ft. and an overfall of 1,150 ft. across the Colorado River, together with a gate house, pump and electric power-house, reservoir force mains and general pipe distribution system involving an estimated expense of over $1,260,000. In May, 1890, Mr. J. P. Frizell, an experienced and well known engineer, was appointed engineer of the Board under a written contract to design and superintend the above construction.

His relations with the Mayor, who was chairman of the appointing Board of Public Works, of 11 members, soon became strained. This was brought about by the Mayor's proposing and insisting on radical and technical changes of the design and construction, his interference with the engineer's staff, and the making of surveys, plans and contracts bearing his own signature without any reference to the engineer. This terminated in his assuming direction of the engineer's chief assistant, and his removal of the engineer's original office, compelling the engineer to establish himself in an inspector's office. Finally, the Mayor came upon the work and gave orders, and instructed the contractor to do work not contemplated or approved by the engineer.

The engineer then informally notified the Board of his intention to resign if not relieved of these embarrassments. The Board disapproved of the Mayor's action, and the Mayor tendered his resignation, whereupon the Board unanimously agreed with the Mayor, but the engineer continued his duties.

The original design was for a flat-topped dam suitable to receive a possible future movable dam or flashboards, and that the impounded water should be withdrawn for mechanical and other purposes by a canal built on a plateau at the level of the top of the dam. After the expenditure of $21,000 on the construction of 900 ft. of this canal, the Mayor had a prospective bidder prepare estimates, plans and specifications for a system of iron pipe conduits to supersede the canal, and he also proposed the insertion of gates in the dam, and the use of temporary water wheels before building the dam to its full height. He insisted upon the discontinuance of the use of iron bolts in exposed stone masonry of the dam, because, according to his experience, they would burst the granite; he also contradicted the correctness of the engineer's plans for water distribution system, and thereafter employed the engineer's chief draftsman to replace them according to his own instructions. The Mayor further proposed to round the down-stream crest of the dam, to change the location of the pump and power-house from a distant satisfactory location on the canal to an inaccessible perpendicular wall of rock immediately below the face of the dam, to construct a 75,000,000 or 100,000,000-gallon reservoir in porous limestone or chalk foundations, and to carry its force main across the river on headers projecting from the up-stream face of the dam 5 ft. below the crest.

All of these changes were opposed by the engineer, who demonstrated that gates in the dam were useless, that temporary water wheels were chimerical, that iron dowels and bolts were necessary, that the pipe conduits would cost ten times as much as the canal, and that the location of the water wheels close to the dam would jeopardize its masonry and produce injurious disturbance in the rock at its toe. He argued that there was no difficulty in laying the force pipe on the earth bottom, but it would be exposed to shocks from drifts and boats if laid on headers, that the reservoir being only useful to supply clear water when that stored by the dam became turbid during a flood, it could be better supplied from an excellent adjacent spring yielding 3,000,000 gallons a day, and he advanced beside the doubtful possibility of economically constructing the reservoir.

The engineer had designed with great consideration the angular-topped cross-section of the dam adopted. For four days out of five the flow over the dam is estimated not to exceed 1,000 cu. ft. per diem, and for half that time not more than 700. Its floods rise and fall with great rapidity. The greatest recent freshet was one of 45 ft., in 1889, and in 1891 it rose 25 ft. in three or four hours, and in two days subsided to 2 or 3 ft. above low water. The engineer did not, therefore apprehend serious abrasion. One, two or three times a year there is a short rush of water, not continued to exclude access or inspection and remedial measures which were contemplated in arrangements for interrupting the total flow of the stream for weeks at a time.

The engineer believed the success of the enterprise to be threatened more by lack of water than by its excess, and the frequent rains in the watershed would naturally increase the water power, if available; an increased depth of 8 ft. above the top of the dam, producing 1,000 HP. for 80 days. This level could be practically maintained by movable flashboards, for which a wide flat top of the dam was necessary.

The Board, becoming perplexed whether to follow the Mayor's dictation or the engineer's plans, retained a prominent hydraulic engineer to investigate and advise. Upon his arrival, this engineer was introduced to the Board and their engineer, with the Mayor's distinct statement that he was "to advise the former, not to consult with the latter." He then examined the engineer's plans, received his data, made independent investigations and submitted a report, which, without any reference to the engineer in charge, is adverse to some of the features of construction, and recommends certain changes substantially in accordance with the Mayor's plans, viz., to make a curved face and narrower top to the dam, the location of the power-house near the toe of the dam, the provision of separate wheel pits and penstocks for the city's electric and pump plants, and a separate supply from above the dam by pipe conduits, and to construct a settling reservoir.

The curved face of the new profile is represented to conform nearly to the theoretical form of a medium flood stream, so as "to cause even the highest flood to glide down the fall without shock upon the face of the dam or the soft rock foundation." An accompanying diagram of the cross-section of dam under construction showed the theoretical form of 15-ft. flood passing over the crest, and the manner in which it might act destructively upon the dam, with an assumed total flow of 200,000 or 250,000 cu. ft. per second, and a trajectory of the falling sheet of water passing down through 45 ft. of standing water in the pool below in an unbroken solid stream acquiring velocity as it would acquire in falling through the air.

The report also predicted scouring of the sand bank below the dam by the first floods after the new regimen of the river should have been established, so that it would be wise to locate the power house on the revetment wall extending 250 ft. down stream from the toe of the dam.

The engineer had no opportunity to answer or comment on the report. After its publication he pointed out that the diagram of the dam's overflow really corresponded to a total flow of 431,250 cu. ft., per second, and that the trajectory and velocity could not exist with the water cushion below, which was apparently disregarded; that the costly changes of dam and penstocks were only designed for the contingency of rare floods, occurring perhaps three times in a century, and lasting but a few hours then, and that during 1891 there was only one day when the depth on the dam would have been 6 ft. and back water 20 ft., so as to reduce the efficiency of a wheel drawing from the canal to 54% of its full power.

As soon as the investigating and advisory report was presented to the Board they accepted it, and invited its author to prepare the detailed plans suggested therein; he accepted the engagement as consulting engineer, and in a few days the engineer in previous charge of design and construction tendered his resignation, which was accepted.

M. Am. Soc. C. E.

(The editor then makes the following statement:—Ed. Eng. News.)

(Copies of this letter were sent to J. T. Fanning, M. Am. Soc. C. E., the engineer engaged to investigate and advise, and to the Secretary of the Board of Public Works of Austin. We have received in comment and reply the following letter:)

Sir: I have your courteous favor of Nov. 19, containing proof of correspondence signed "M. Am. Soc. C. E.," with permission to comment thereon. I am sure that the members of the American Society of Civil Engineers will resent such use of this signature as may imply this article to have been written by any one of them, indiscriminately, since the article is an attack upon an honorable Board of Public Works of an American city, viz., Austin, Tex.

The writer has been informed and has learned through personal acquaintance that the individual members of the Board were elected by the citizens of Austin from among their most intelligent, honorable and successful business men, and for their special fitness to direct the large and important public works of water-power, water supply and electric lighting which the city was about to commence.

The writer was invited, through correspondence attested by the City Clerk, to examine and report on these works as soon as the city had made its first preliminary surveys, but was prevented by engagements then in hand from assuming the immediate duties of consulting engineer. The Mayor, who is President of the Board of Public Works, and who is more particularly attacked in this anonymous article, is known by the writer to be a man of marked mechanical ability. He was the original projector of this enterprise, in which he has been heartily supported by his associates. He was elected Mayor by a large majority, in a city that has usually given large majorities to the candidates of the opposite party, and re-elected almost unanimously for a second term because of his recognized ability and fitness to supervise a work like this. As a mill owner and builder, as a contractor for engineering works of many years' experience, and as designer and contractor for public buildings, he is eminently qualified by experience to be President of a Board of Public Works, as well as Mayor, during the construction by the city of such works as these, and to supervise their construction. For the same reasons, and because of his intense studies of this great work during several years before the commencement by the city, he was well qualified to pass judgment upon any plans thereof, and to detect errors therein or nonconformities with good practical construction.

In relation to the general charge against the Board that "the engineer had no opportunity to answer or comment on the report of the consulting engineer," the writer has knowledge to the extent that all suggestions of changes in works in progress were first made to and discussed personally with Mr. Frizell and that Mr. Frizell sat with the Board when they were verbally stated to the Board, and he again sat with the Board when the typed copy of the report was read, about two weeks later.

The suggestions relating to changes in works and to future works were made to the engineer with the impression that he would continue in charge. The writer saw no official act of the Board implying discourtesy to the engineer. They are all gentlemen who I think would prefer forbearance even until it ceased to be a virtue, and if they did lose confidence in the ability and methods of the engineer, as implied in the article, and intimated individually that they preferred to have the assistant engineer continue in charge of the work of the dam, I infer that they saw sufficient reasons therefor. J. T. Fanning.

Since the above was in type the following letter from Mr. Frizell, dated Boston, Dec. 7, 1892, has appeared in the columns of our contemporary, and we add it that the statement of the issues on both sides of the controversy may be complete.

Sir: I notice in your issue of Dec. 3 an article in which my name is mentioned, together with some comments thereon, by Mr. J. T. Fanning. Judging from some rather unkind insinuations toward the close of these comments, I judge that Mr. Fanning believed me to be the writer of the article. In this he is mistaken. The article was not written by me nor at my suggestion, though the facts stated are correct, so far as I know.

Mr. Fanning's comments were a disappointment to me. I did not perceive any occasion to regard the article as an attack on the Board of Public Works of Austin. It did not appear to me that this Board was referred to any farther than was necessary to set forth Mr. Fanning's behavior in its true light. It was his own conduct that called for justification. The engineering public has no interest in the doings of this Board; it may have some interest in professional honesty and decency. It speaks well for Mr. Fanning's kindness of heart that he should regard the good name of his employers as of more importance than his own.

I cannot but receive it unkindly of Mr. Fanning that he should so promptly answer your article, in which his name was not mentioned, while neglecting for more than 60 days to notice an article written by me in Engineering News, in which his name was mentioned.

Joseph P. Frizell.

A MACHINE SHOP WITH WEAVING SHED ROOF.*

By John E. Sweet.

When the size and form of a shop have to conform to the lot upon which it is located, it will depend upon the genius of the designer for its success; but if the designer simply builds the building as large as the lot, and leave the arrangement for future study, or fate, it is liable to be a failure. The plan should be studied to arrange things in the most convenient form. In many respects the weaving-shed plan—that is, a one-story structure in sections, separately roofed, with the north sloping side of glass—has advantages. As to ventilation, in its simplest form it may be inferior, but the ventilation is easily controlled when the problem is once fairly attacked.

Common and fashionable as is the salt-block construction—that is, a central high section with a gallery on either side—this form when used in a shop so small that one foreman has control of all the machinery has this disadvantage, that he has to "see-saw" across from side to side, worming his way through the erecting section, whereas with the erecting floor at one side the machine tools are concentrated. With a small shop, too, the climbing up and down stairs is not only a nuisance, but absolutely costly. Things can be moved in an elevator very cheaply; but carting, loading, unloading, and carting again spoils the economy. It is doubtful if there is any saving in two or more storied shops, except in real estate; and when as much ground has to be left idle to get light as is covered by buildings, then the saving in real estate is small, unless the buildings are more than two stories in height.

The advantage of the one-story weaving-shed roof plan is that the building can be extended to any length in either direction, and to any width in one direction, without interference with light. It is also easily heated, and everything is on one floor, and that floor a solid one. The trouble apprehended from ice, snow, and water has no foundation in fact, and if dealt with in the way described later, need not give one a moment's anxiety. The section for traveling cranes can be of any height and width, without interfering with the weaving-shed structure or light, by placing it on the south side.

Machine shop floors are a problem, and while those made of dirt, like some of the French ones, seem to last the longest, they are hardly satisfactory; neither are the English brick floors. The following, used in the works of the Straight Line Engine Co., is believed to be better than most of the floors heretofore constructed. The earth was excavated to a depth of 27 ins. below the floor line, and rolled with a heavy roller, the soft places filled, and again rolled and levelled. Building-stones of the cheapest sort—that is, stone too poor for foundation walls—were dumped on the ground, and men set to sorting the largest pieces and closely packing them on the ground; a strip of two or three feet of this work was kept in advance of the other filling, so as to insure its solid character. Upon this was a layer of the smaller stone, then broken stone, coarse gravel, fine gravel, and, lastly, sand. There is no other possible way in which each grade can be made to retain its place, except by reversing the process and putting the larger above the smaller. If mixed indiscriminately, the fine will work to the bottom and the coarse come to the top. By following the plan given, a solid foundation is secured upon which is placed nothing but 2-in. hemlock plank running one way, with a 1-in. planed and jointed, but not matched, floor running the other way. The advantage of the thin top is that when there is a hole worn through, it is but an inch deep at the most, the plain strips of uniform width make it easy to repair. This makes a floor on which anything can be set anywhere, except the largest of the machine tools requiring separate foundations.

Some accounts of the English practice give 16 ft. as the width of spans or bays, but in the works above mentioned 32 ft. is used, 8 ft. being the unit upon which the building is constructed. In a more extended plant, 10 or 12 ft. would be proper. The posts are 8 ft. or 16 ft. between centers, and all the roof trusses 8 ft. The roof is simply 1½-in. pine plank, 16 ft. long, planed and matched, planed side down, nailed to thin strips of basswood riveted between the two angle-irons which form the rafters, covered with ribbed, not corrugated, iron; and the flat roof over the traveling-crane section is the same, except the gravel roof.

In the construction of the posts and roof, by making each member of two pieces ⅝ or ¾ in. apart, between which bolts can be passed, a convenient means is at hand to fasten anything anywhere. The iron structure is more expensive than wood, but lighter, exempt from fire, and, with the provision for bolt attachment above referred to, more convenient. The trusses are strong enough to hold three or four tons besides the roof, so that any pieces of machinery or work which are liable to be handled can be raised by tackle attached to the trusses, in whatever part of the place they may be.

The question of snow, which seems to be the bugbear to every one first thinking of the weaving-shed roof, is one requiring hardly a second thought. Making the gutter of cast iron, as shown in Figs. 2 and 3, or any convenient shape, and putting it inside the building with the heating pipes adjacent, is all which is required. Keeping the gutters clean is all there is to it, and snow and ice will thaw sooner in cast iron than on the wood planking, when the heat comes from the lower side.

A distance of 8 ft. between centers would seem to be too near together for posts; but by making benches 12 ft. long, supported by two posts, leaving 4 ft. spaces between the ends of the benches, the apparent objection vanishes where the bays are as wide as 32 ft. In a building for large work, with 10 ft. between trusses, the bays could easily be 40 or more feet, with 8 ft. of glass on the northern slope.

The design of the roof truss is very simple, as shown in the cross-section, Fig. 1. While economy of material would dictate iron of different section and weight, to save bother we used all alike, and as the accidental loads are unknown quantities placed in unknown positions, perhaps that was as well as applied high science.

In the weaving-shed system of lighting the annual cost for repairs of broken glass is practically nothing, and in this connection the writer volunteers to say that he believes an erroneous idea is pretty universally prevalent in regard to the most economical size for lights of glass for shop-lighting. The theory is that the small-size lights for various reasons are the most economical. But after a long observation, the evidence to me is conclusive that the larger the lights, the less the cost for repairs. Large lights stand far more punishment, and the workmen have some respect for a light of glass which costs a dollar, but none whatever for 10 × 15-in. glass. Whether these are the reasons or not, the fact remains that where in one part of our works the annual breakage of 10 × 15-in. glass does not fall below 100 panes, there is another part where the large lights were equally exposed, and there was but a single light broken in two years. The writer's observations in this direction have not been confined to a single case, and it will be to the interest of those contemplating new buildings or changes to investigate this subject.

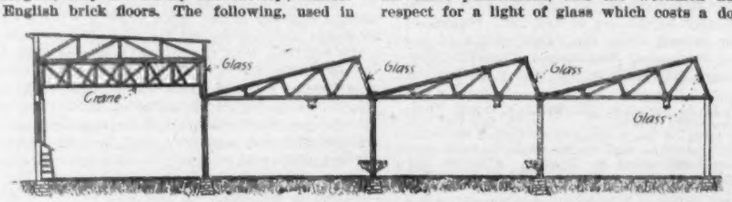


FIG. 1. CROSS SECTION OF MACHINE SHOP.

Discussion.

Mr. C. J. H. Woodbury said that the question of drainage was an important one in the construction of most ground floors, and while it might not give trouble on the Syracuse meadows where the Straight Line engine works are located, most New England mills, built near water powers, have to pay especial attention to this matter. In this country, where leather shoes are the rule, a wooden floor seems to be a necessity, and the question is how to preserve it from decay where it is laid directly on the earth. One of the best preservatives, probably, for floors so laid is air slaked lime. He knew of a machine shop floor which was laid directly on a 2-in. layer of air slaked lime, and is sound to-day after 25 years' service. As proof of the preservative qualities of lime upon wood, he instanced common building lath, which are invariably found perfectly sound when a building is demolished. Portland cement concrete has been tried by many; but spruce or hemlock will decay when placed in contact with it in four or five years. A coal tar concrete, however, is a perfect antiseptic, and floors laid directly on it

* Topical discussion presented at the November meeting of the American Society of Mechanical Engineers.

are still sound after 25 years of service. It excludes all moisture from below. In a Waltham mill built 40 years ago, the foundation for the floor was a weak concrete, probably one part cement to 10 or 12 of sand, and melted coal tar was poured on top. On this was laid a 1½-in. spruce floor, with a hard wood surface, and the bottom floor is still sound. Spent molding sand is a material for shop floors which has been used with much success, and resin has been melted and poured around girders embedded in the earth and underneath the floor, and has served to exclude moisture and prevent decay.

Professor Sweet has been over-modest in describing

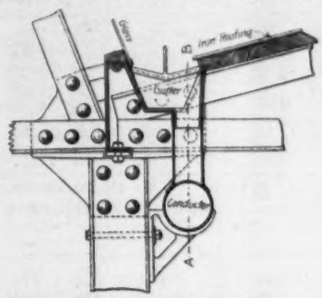


Fig. 1. Cross Section Showing Roof Gutter.

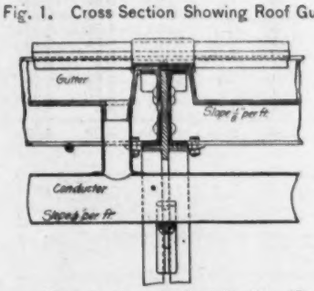


Fig. 2. Longitudinal Section AB.

the buildings at the Straight Line Engine Works. The ridge and furrow roof, which has been adopted there, has, for the first time, been successfully adapted to the American climate. The success is due largely to the ingenious method of drainage of the roof. It is questionable, however, whether an arrangement which would give better results as respects heating the building would not be effected by warming the gutters by direct heat from steam pipes.

Mr. J. F. Holloway said that he at one time used wood block paving for a machine shop floor, and with excellent success.

BLUE PRINT PAPER FOR CLOUDY WEATHER.

The annoyance of long continued cloudy weather in an office requiring a large amount of blue printing has doubtless been experienced by many of our readers. In our issue of May 23, 1891, we published a simple formula for a rapid blue printing paper, with a record of experience with it furnished to us by Mr. F. H. Latimer, of Vancouver, B. C. A correspondent writes us concerning it:

On account of cloudy weather our office has been several hundred prints behind with blue printing. In reading over my Engineering News' file for 1891 I happened to see a blue print formula for cloudy weather in the issue of May 23. We tried it and found it to be a grand success, getting prints in 15 minutes in very cloudy weather, in place of several hours.

In justice to all your similarly afflicted subscribers you should print this formula in bold face type on your editorial page.

As some of our readers who do not bind their files may not be able to find the original paper, we reprint it herewith.

Mr. F. H. Latimer, of Vancouver, B. C., writes us that a year or two ago, while experimenting with blue printing processes, more particularly with the object of getting bright blues and clear white lines, he found that after the usual washing a bath of quite dilute acid, such as hydrochloric, or, better, oxalic, would often greatly improve the clearness of the prints, a marked cause of dirty blues being a gradual altering of the solutions even when kept separate till just before using, though poor quality of the ammonio-citrate of iron seemed to have much to do with the results.

During the experiments he also found that an addition of oxalic acid to the ordinary blue print mixture materially lessened the time of necessary exposure. The solutions used were:

1. Ammonio-citrate of iron, 120 grains; water 1 fluid ounce; to which is added a few drops of strong ammonia solution till the odor is quite perceptible.

2. Potassium ferricyanide, 105 grains; water, 1 fluid ounce.

3. Saturated solution of oxalic acid.

Equal quantities of (1) and (2) are taken (a); and after being mixed (3) is added as required and the mixture used at once.

Taking, say, in the proportion of 10 ounces of the mixture (a) and adding thereto (b) one ounce; (c) two ounces; or (d) three ounces of (3); the relative rapidity of the coated papers will be closely, in very dull light, as 1 : 2½ : 5 : 10, (d) paper being thus about 10 times as rapid printing as (a) in the light mentioned. For example, a print was made from a tracing on linen in 35 minutes on Feb. 25, 11:30 a. m., on (d) paper during a snow-storm, the light being quite dull, while ordinary paper takes the greater part of a day in an equal light.

This great difference only holds good in dark, cloudy weather; as, if comparisons are made in direct sunlight, (d) paper is only three to four times as rapid as (a). An explanation of this probably is, that a weak light that will reduce the oxalic acid mixture (partly ferric oxalate) has but a faint starting or continuing action on the ferric citrate, while with a strong light both commence at once.

For all ordinary purposes it is better not to use a greater percentage than 20% (c) of the oxalic acid solution, as it is difficult to get the lines to wash white with a higher percentage, even with thick black lines on the tracing or negative; and the more sensitive the paper the shorter time it will keep good even in the dark, and also the greater care required in its preparation and use. Some hard close grained paper that does not absorb much of the iron solution, such as parchment paper (Dietzgen & Co.), Mr. Latimer has found to give the best results in this process, as, indeed, for all blue print work. To get the clearest prints the paper is better prepared a short time before using in a dark room by gas or lamp light or very weak sunlight.

Ferric oxalate and potassium ferricyanide mixed makes a very rapid printing paper, and can be made considerably cheaper than with the ferric citrate; but it is too sensitive for ordinary work, and requires more care than can be given to it in engineering work, as a rule. Ferric chloride is also more rapid and cheaper, but has the same disadvantages. They seem also to wash off the paper more than the citrate, though different sizing of the paper might remedy this. The only way to get white lines with the two latter, Mr. Latimer has found, is to make the ferric salts frequently, so as to have them fresh, keeping the solutions in the dark or deep red light only.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Liability for Injury from Drilling Into Unexploded Dynamite.

In an action for injuries occasioned by the explosion of dynamite, while blasting, it appeared that a number of holes had been drilled and loaded, and that, when the blasters returned from cover after the explosions, it was supposed that each one had blown out. The boss said that one had blown out without effect, and become full of dirt, and told the men to drill it out again. One of the men expressed some fear, but went to work, and, while holding the drill, was injured by an explosion. He might easily have determined by examination whether an explosion had taken place, and so might the boss. Under the circumstances his negligence was such, notwithstanding the negligence of the boss, as to prevent recovery. (Seston v. Turner. Supr. Ct. of Appeals of Va., 15 S. E. Rep., 862.)

A State Has No Right to Enlarge a Water Course on Private Land.

A right, acquired by the state through adverse user, to divert water from a river into a stream flowing through a person's land, gives the state no title by adverse possession to land under the stream, and hence no right to broaden and deepen its bed. And where the entry of the state on land for excavation is wrongful, the state is liable for all trespasses while excavating committed by the contractor with the acquiescence of the agent of the state. (Colman v. Smith. Ct. of Appeals of N. Y., 31 N. E. Rep., 902.)

Effect on Patent of Delay in Filing Survey.

Under the statute requiring a survey of vacant land to be deposited with the register within six months from the time it is made, a patent issued on a survey deposited nearly 10 years thereafter conveys no title. (Adams v. Frazier. Ct. of Appeals of Ky., 20 S. W. Rep., 268.)

Liability of Railway Company for Obstructing Water Course.

Where a railway company, in repairing its road, altered its embankment on the sides of a stream running through a farmer's land, so as to extend the embankment further into the stream, thus narrowing the passageway of the water, and causing it at times to pond back on such person's land, the railway company is liable for any injury to the owner of the land's crops resulting therefrom. And he was not guilty of contributory negligence because he planted crops on the land knowing that such land was liable to be overflowed and the crops injured. Simple acquiescence in the railway company's action by the owner of such land for several years, or his failure to notify the railway company of his injury, cannot, by way of estoppel or otherwise, affect his common-law remedy. (Knight v. Albemarle & R. R. Co. Supr. Ct. of N. C., 15 S. E. Rep., 929.)

Dedication and Subsequent Diversion of Street for Railway Purposes.

In an action by a city to restrain a company from laying a railway track in a street, the trial court found that the original owner, in laying out the street on a "map, selling lots, and allowing the same to be used, expressed an equivocal and qualified intent to permit such user as a public highway, subject to the right of revocation;" and that, in permitting defendant to lay certain tracks and to build a freight house in the street, such owner had expressed an intent to revoke such qualified dedication before it was accepted by plaintiff, or by user by the public. At the request of plaintiff, the court found "that there has been a continuous user of the part of the public of the" street "since in or before the year 1845, except as the same was temporarily deflected by the laying of said railway tracks and the erection of said freight house; that from 1845 down to the time of the commencement of the action (1885), the public user of the street has been general, continuous and exclusive for all the purposes of a public street, . . . and that before the construction of the railway track, and the dedication of the street to the public had been accepted by the public by user." At the request of the defendant, the court found "that there never has been any dedication of the street for high way purposes" and "that there never has existed a public highway" at the place alleged by plaintiff. Under the circumstances the city was entitled to the finding most favorable to it; and as there was dedication of the land as a street by the original owner, and an acceptance by the public, it was entitled to the relief sought, against the railway company, which was a subsequent grantee. (City of Cohoes v. Delaware & H. Canal Co. Ct. of Appeals of N. Y., 31 N. E. Rep., 887.)

Macadamizing as Paving.

"Macadamizing," as shown by the employment of the word in the Pennsylvania statutes of 1887 and 1889, where it is used with "paving" connected by "and" or "or," to designate the general character of street improvements, is a species of paving, within the rule that, where streets have been once paved, they cannot be repaved at the expense of abutting owners. (City of Harrisburg v. Segelbaum. Supr. Ct. of Penn., 24 At. Rep., 1,070.)

Excavating Beyond City Limits.

The acts of the city authorities in cutting or causing to be cut a deep ditch or excavation near, in, and upon the side of a lot outside the limits of the city, thereby causing a person's land and fence to fall and cave into said ditch or excavation, to his damage, are ultra vires, they having, at the time the acts were done, no power or jurisdiction over the land in question. Consequently the municipal corporation is not liable for damages resulting from such acts. (Lord v. Mayor. Supr. Ct. of Georgia, 15 S. E. Rep., 818.)

Duty of Borough in Laying Water Pipe.

It is the duty of a borough in laying a water pipe along a traveled highway to construct it in a safe manner, and to exercise due diligence to keep it in such a condition as not to endanger the safety of people lawfully passing. (Baker v. Borough of North East. Supr. Ct. of Penna., 24 At. Rep., 1,079.)

Claims for Overflow in New York State.

Under the New York statute of 1885, authorizing the Board of Claims to hear and determine the claims for damages of persons owning land bordering on Seneca Lake, occasioned by reason of the overflow of water, caused by the state dam at Waterloo, and other prior legislation, the effect of which is, while providing for the maintenance of the said dam and other improvements, not to raise the naturnl level of the water, the question of allowance of such claims must be determined with reference solely to the natural level, and not with reference to whether it would be lower than it is, if the dam were not there, or if the improvements in deepening and widening were considered. And a finding of fact by the Board of Claims, based on a conflict of evidence, or on any evidence, is not subject to review on appeal. (Bower v. State. Ct. of Appeals of N. Y., 31 N. E. Rep., 804.)

Piers and Land Below Low Water Mark.

Even if the city of Brooklyn extends to low-water mark only of the Long Island shore, it includes all piers and other artificial erections below low-water mark, and such piers in Gowanus Bay are within the jurisdiction of the city assessors. And, even if land below low-water mark of Gowanus Bay, not made an accretion by alluvion or the erection of piers, is not in the city of Brooklyn, but in the city of New York, such land, where it is part of an occupied lot, and the other part is above low-water mark, and in the city of Brooklyn, is properly assessed in such city, under the statute providing that, when the line between two counties divides a farm or lot, the same shall be taxed, if occupied in the county where the occupant resides. (Tebo v. City of Brooklyn. Ct. of Ap. of N. Y., 31 N. E. Rep., 984.)

Liability for Obstruction of Non-Navigable Stream.

Where the owner of land abutting on a non-navigable stream constructs an embankment in front of his premises, extending somewhat into the channel, and the embankment, although not obstructing the water in its ordinary flow, forces it during an unusual freshet on the land on the opposite shore, and so wears away the land, such owner is liable. Proof as to the cost of restoring the land, and of the diminution in its market value, is alike admissible, in such a case, in an action for damages, as either measure is likely to obtain, according as one or the other is found to be the less. (Hartshorn v. Chaddock. Ct. of Ap. of N. Y., 31 N. E. Rep., 907.)

Railway Embankment Extending Over Adjoining Land.

Where a railway company, in constructing its railroad, constructs an embankment upon which it places its railway tracks and the railway tracks are not placed upon the adjoining land, but the embankment extends over and upon it, the owner of the land may maintain an action against the railway company as for a permanent taking and appropriation of a portion of his land, and for damages to the extent of the depreciation in value of his land caused by such taking and appropriation. (Wichita & W. R. Co. v. Fechheimer. Supr. Ct. of Kan., 31 Pac. Rep., 127.)

THE RAILWAY MILEAGE OF THE WORLD.

The total mileage of railway lines in the world is 370,281 miles according to Extra Bulletin No. 24 just issued from the Census Office. This bulletin has been prepared by Mr. Henry C. Adams, the statistician of the Interstate Commerce Commission and may reasonably be said to bear the authority of that body as well as that of the United States census. Notwithstanding this high authority, however, a very considerable number of small errors appear in the figures given. These have already been seized upon by a justly censorious contemporary and we shall leave the flagellation of the guilty to it. In brief these errors are quite small individually and even in the aggregate are of no very great amount, and do not practically affect the general conclusions—and general conclusions only are possible—to be drawn from the very interesting diagrams based upon them which we reproduce with some changes in this issue.

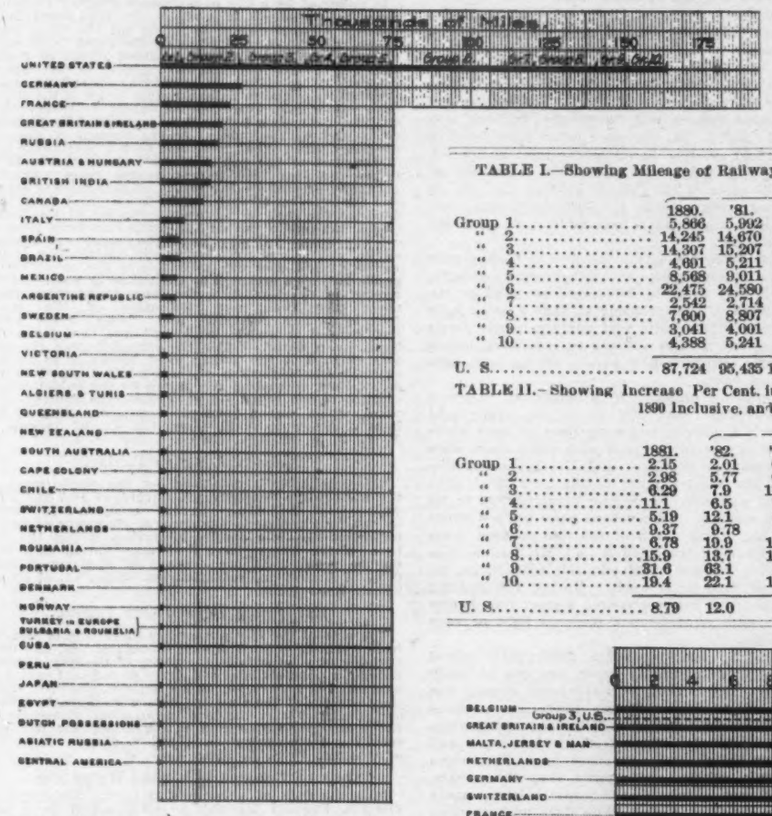


FIG. 1.. DIAGRAM SHOWING COMPARATIVE RAILWAY MILEAGE OF THE DIFFERENT COUNTRIES OF THE WORLD.

In considering the railway mileage of the different countries of the world as shown graphically by the diagram (Fig. 1), several facts in regard to this latest and most important phase of industrial development present themselves forcibly to our attention. First, it will be noticed that the development of extensive transportation systems is peculiar to people of Christian civilization. North America and Europe contain 319,802 miles, or 86% of the total mileage of the world. Further, it is noticeable that English speaking people are responsible for a larger share of the world's railway mileage than all other peoples combined. Another fact, and one which amply justifies the assertion that the railway problem is of peculiar importance in this country, is that the United States have 44.18% of the railway mileage of the world. Considering the complicated conditions under which this railway was built and exists, and the vast increase in material prosperity which its construction has largely brought about; its necessarily disturbing influences upon land values and its effect upon other social and industrial conditions too numerous to mention, it is no wonder that our political machinery has failed to adjust itself perfectly to its rapidly expanding duties and that public discontent with our railways is rife. Of course many of these conditions are the same in other countries as in this, but many of them, and in some respects these are the most important, are not; and this should be borne in mind in making comparisons between the United States and other countries.

The facts already mentioned are emphasized in the diagrams (Figs. 2 and 3) showing the miles of railway per 100 sq. miles of territory and per 10,000 inhabitants in different countries. In these diagrams we have interpolated broken lines showing the mileage per 100 sq. miles of territory and per 10,000 population for each of the ten groups into which the United States are divided. The territory embraced in each of these groups is shown in the skeleton map (Fig. 4) given herewith. Taking first the diagram showing the mileage of railway per 10,000 population, it will be seen that the first six countries showing the greatest development of their transportation system according to population are English speaking countries. It is noteworthy also that the railway systems of the first five of these countries have been built, or, as with Canada, heavily subsidized, by their respective governments. It should not, however, be inferred from this that their prominence in the diagram is due to this fact entirely, although it is responsible for it in a considerable measure. Nearly all of these lines have been constructed through sparsely settled territory and largely for colonization purposes. An examination of the other diagrams, (Fig. 2) shows that these countries stand very low in the scale of mileage of railway per 100 sq. miles of territory.

A further comparison of the two diagrams shows still greater divergences. The fact that Belgium and other European countries stand so far in the lead in mileage per 100 sq. miles of territory is of course largely due to their limited area and the density and concentration of their population. On the other hand the diffusion of the population in the Australian colonies and Canada is not alone sufficient to account for their large mileage per capita and their small mileage per amount of territory. As compared with Europe the demands in these countries for railway facilities is very large. For example take the United States, where the territorial conditions are similar. It has, according to the figures given in the Bulletin, but which we have omitted, 26.66 miles of railway per 10,000 inhabitants, while Europe, taken as a whole, has only 3.84 miles per 10,000 inhabitants. That this cannot be wholly attributed to the respective diffu-

TABLE I.—Showing Mileage of Railway in the United States by Territorial Groups, for each year, 1880 to 1890 inclusive.

	Miles of Line										
	1880.	'81.	'82.	'83.	'84.	'85.	'86.	'87.	'88.	'89.	'90.
Group 1	5,866	5,992	6,112	6,173	6,222	6,253	6,308	6,402	6,531	6,606	6,878
" 2	14,245	14,670	15,516	16,539	17,085	17,248	17,444	17,653	17,833	17,994	18,614
" 3	14,307	15,207	16,408	19,345	19,582	19,982	20,317	20,673	21,004	21,244	21,718
" 4	4,891	5,211	5,550	5,948	6,302	6,332	6,606	7,244	7,855	8,225	9,032
" 5	8,568	9,011	10,099	11,076	12,042	12,955	13,642	14,350	15,986	16,979	18,635
" 6	22,475	24,580	26,984	28,278	29,224	29,400	31,428	33,055	35,050	36,346	37,463
" 7	2,542	2,714	3,255	3,723	4,430	4,769	5,514	7,211	7,695	8,087	8,887
" 8	7,600	8,807	10,018	11,334	11,615	11,748	12,351	17,173	19,162	19,809	20,355
" 9	3,041	4,001	6,526	6,763	6,875	7,306	7,672	8,600	9,060	9,238	9,854
" 10	4,388	5,241	6,401	7,673	8,416	9,189	9,478	10,216	11,002	11,607	12,160
U. S.	87,724	95,435	106,870	116,851	121,794	125,182	130,760	142,637	151,136	156,136	163,597

TABLE II.—Showing Increase Per Cent. in Railway Mileage by Territorial Groups for Each Year, 1881 to 1890 Inclusive, and Total Increase Per Cent. for Ten Years.

	Increase per cent.										Total inc. % 1890 over 1880.
	1881.	'82.	'83.	'84.	'85.	'86.	'87.	'88.	'89.	'90	
Group 1	2.15	2.01	0.99	0.8	0.49	0.89	2.44	1.07	1.15	4.11	17.3
" 2	2.98	5.77	6.6	3.3	0.96	1.14	1.2	1.02	0.9	3.44	30.6
" 3	6.29	7.9	17.9	1.22	2.04	1.68	1.75	2.04	0.71	2.23	51.6
" 4	11.1	6.5	7.18	5.96	0.47	4.33	9.66	8.43	4.71	9.82	93.4
" 5	5.19	12.1	9.68	8.72	7.58	5.31	5.19	11.4	6.21	9.76	117.5
" 6	9.37	9.78	4.79	3.35	0.6	6.89	5.18	6.03	3.7	3.07	66.7
" 7	6.78	19.9	14.36	18.9	7.66	15.6	30.8	6.71	5.1	9.89	249.6
" 8	15.9	13.7	13.1	2.48	1.15	5.13	39.0	11.6	3.38	2.75	168.0
" 9	31.6	63.1	3.62	1.66	6.27	5.02	12.1	5.35	1.97	6.67	224.0
" 10	19.4	22.1	19.8	9.69	9.18	3.14	7.79	7.69	5.5	4.77	177.0
U. S.	8.79	12.0	9.34	4.23	2.78	4.46	9.08	6.05	3.22	4.78	86.5

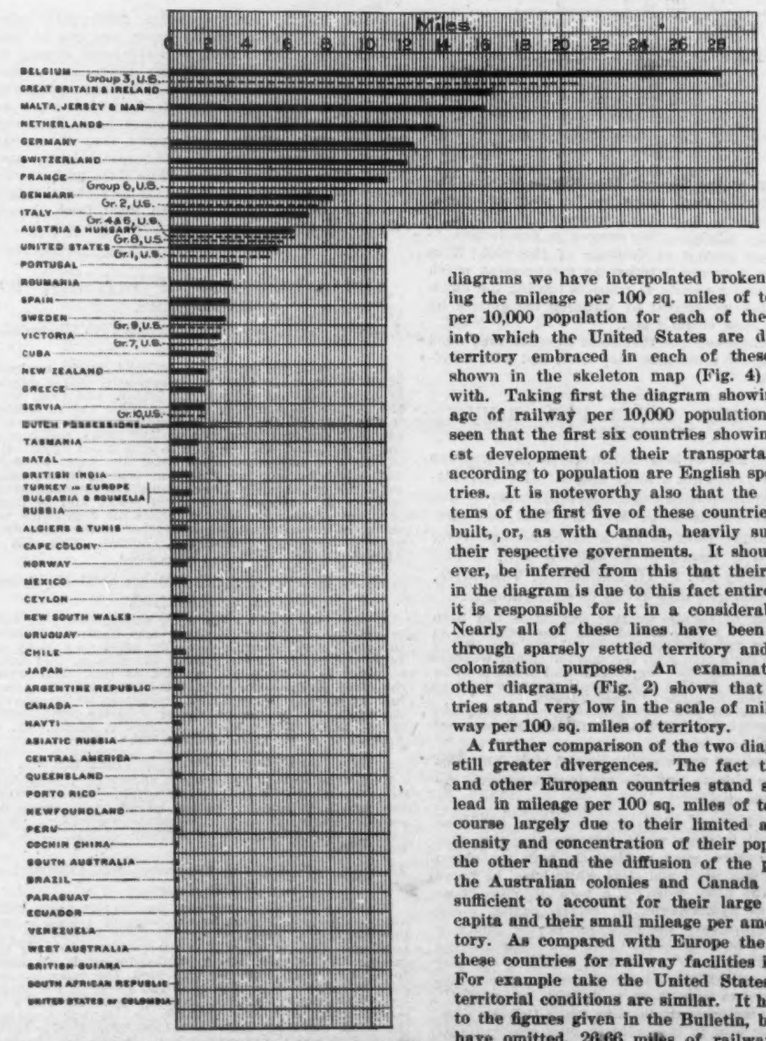


FIG. 2. DIAGRAM SHOWING MILEAGE OF RAILWAY PER 100 SQ. MILES IN THE DIFFERENT COUNTRIES OF THE WORLD.

sion and density of population in the two territories is shown by the fact that the United States has 5.51 miles of railway per 100 sq. miles of territory against 3.62 miles of line per 100 sq. miles of territory in Europe. It is evident that in comparing the railway development of the different countries shown on these diagrams cognizance of these varying conditions must be taken in order to arrive at correct results. In one country the problem has been to reclaim territory for settlement, in another to provide territory already settled with transportation facilities; a well formed national policy has held railway construction in check in one country and in another it has been under no restraint; railways are owned or heavily subsidized by the government in one country while the railway mileage of another is entirely in the hands of corporations.

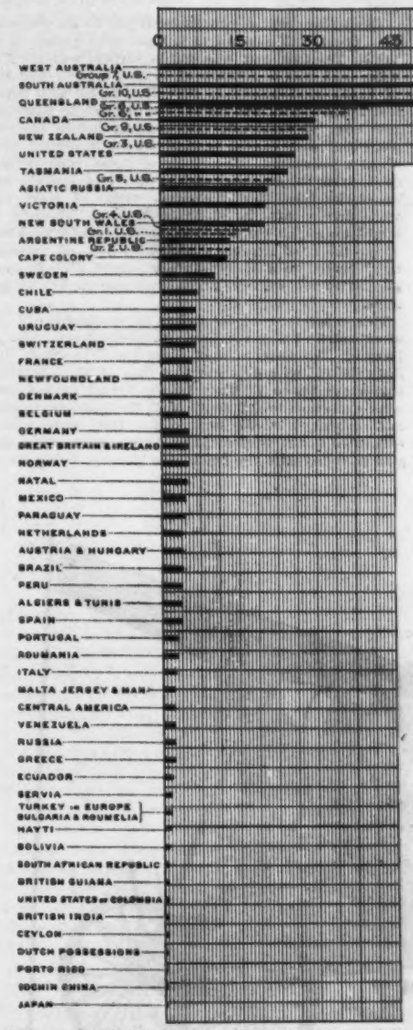


FIG. 3. DIAGRAM SHOWING RAILWAY MILEAGE PER 10,000 POPULATION IN THE DIFFERENT COUNTRIES OF THE WORLD.

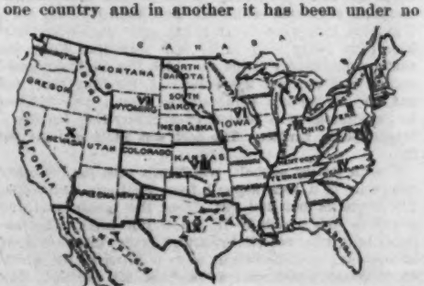


Fig. 4. Subdivisions of the United States adopted by the Interstate Commerce Commission.

In Fig. 5 is shown a diagram giving the mileage of railway in the United States in territorial groups for each year from 1880 to 1890, inclusive. This diagram shows forcibly the enormous increase in the railway mileage in this country during the last decade. To show this more exactly we have rearranged the accompanying tables (Tables I. and II.) from the figures given in the bulletin.

The figures in these two tables in connection with the diagram pretty well explain themselves. There are, however, a few significant facts suggested by them. It will be seen that railway construction in Group 1, has been quite regular during the ten years. In Groups 4 and 5, which comprise the southern states east of the Mississippi River, the construction has been very rapid but has not fluctuated in any great degree from year to year. This is not the case in Groups 2 and 3 comprising the territory through which the trunk lines east of Chicago run, nor in Groups 6, 7 and 8. The chief additions to the railway mileage of Groups 2 and 3 were made in 1882 and 1883, and resulted from the period of speculation and from the building of certain great lines to compete with the established trunk lines. The period of excessive construction in Groups 6, 7 and 8 was somewhat later, 1887, and resulted, as is well known, from the attempt of certain of the great systems entering Chicago from the west to gain control over territory which it was known must ultimately furnish a large traffic. With the exception of these two periods of speculative construction railway building in the United States for the last decade has been quite normal and healthy.

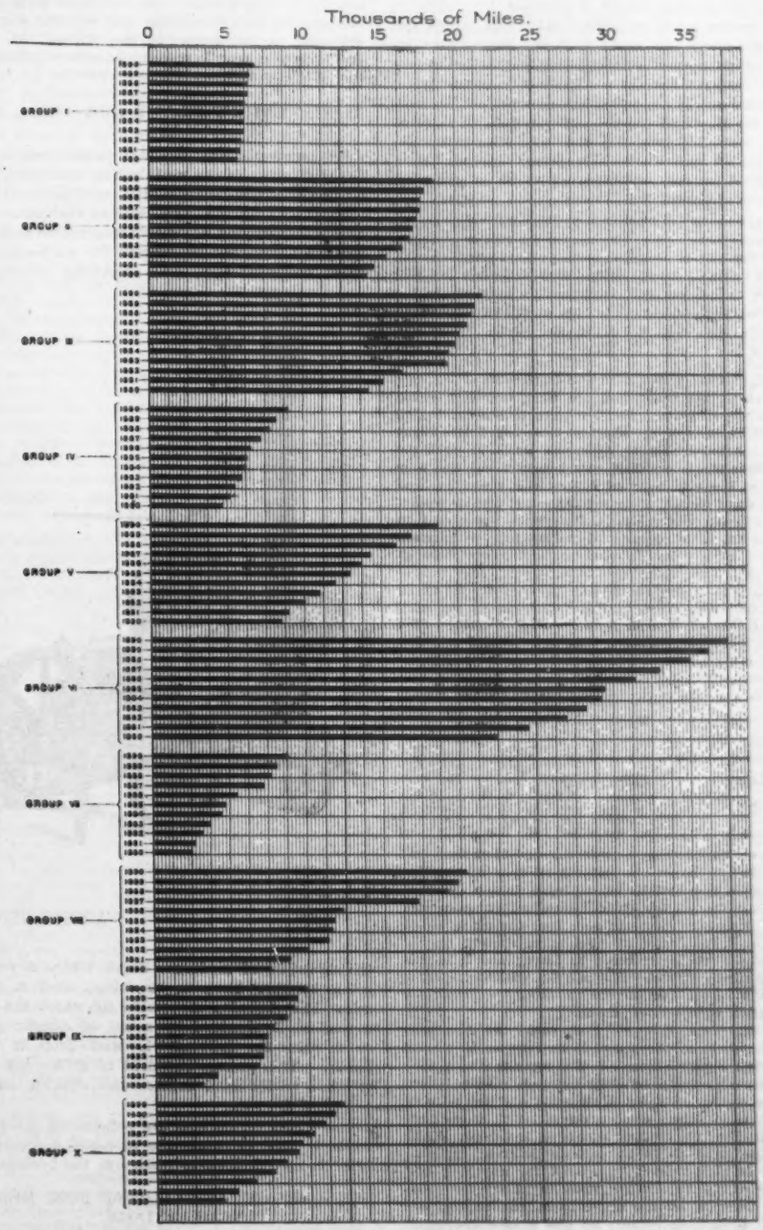


FIG 5. DIAGRAM SHOWING RAILWAY MILEAGE OF THE UNITED STATES BY TERRITORIAL GROUPS FOR EACH YEAR, 1880 TO 1890, INCLUSIVE.

BRIDGE BUILDING IN ENGLAND AND THE UNITED STATES.

Some of the advantages of American bridge building methods over those pursued by British firms have been well illustrated in the bridges on the Transandine Ry. It has been shown that American firms can fill orders in one-fourth the time required by English firms, and at lower prices per ton of finished material.

Our London contemporary "Engineering," in a recent article on the Transandine Railway bridges, gives the particulars in a very entertaining manner, and points out the fact, which is perhaps too little appreciated in this country, that American bridge builders stand in a position to control a large export trade and are rivals from which the British builder has much to fear. We reprint below the portion of our contemporary's article in which this interesting comparison is made. The Transandine Ry. is being constructed by Messrs. J. & E. M. Clark & Co., of London, (See Eng. News, Feb. 13, 1892 for map and illustrated description of the line). The prices quoted below are stated by our contemporary to be as given by this firm of contractors.

The larger bridges on the Transandine Ry. are of American construction. The reason for this is certainly interesting, as it raises an important point on the relative value of American and British bridge building practice, and shows how that practice operates in the matter of securing foreign orders, or orders for foreign countries, which is not quite the same. Time was an important element in the matter; the railway was practically completed, but could not be opened until the bridges were constructed and in position.

Several British bridge-builders were therefore asked to state the time they would require to build a bridge of 246-ft. span, and the shortest time asked was eight months. A cablegram to American firms brought the reply from two that they would deliver all the four bridges of the size required alongside a vessel at New York in eight weeks, while a third asked twelve weeks. There was no alternative. Cables were again sent to the three firms stating the load and the tests to be made when the bridge was in position, and offers were at once sent. The span we have given; the tensile strength of the steel used was to be from 23 to 30 English tons (58,240 lbs. to 67,200 lbs.), per sq. in., with an elongation of 20% in 8 ins. before fracture. The builders were to guarantee that the bridges satisfied the test requirements when in position. The main girders were to be 15 ft. 1 in. c. to c., to carry the single line of meter gage (3 ft. 3⅜ ins.). Here are the offers:

Tenders for Bridge of One Span, 246 ft.

Name.	Price. £.	Weight. tons.	Price per ton. £.	s.	d.	Price cts. per lb.	Delivery. w'ks.
Union Bridge Co.....	2,515	156	16	2	0	3.85	12
Phoenix " "	2,637	156	16	17	8	4.01	8
Edge Moor " "	2,403	164	15	3	5	3.29	8

Time, as we have said, was the consideration, and weight was an important element in view of the distance the bridge had to be conveyed inland, so that the Phoenix Co. got the order, although their price was highest. It is interesting to note that the changing of the material from iron to steel only involved an increase of 5%, the tests being as above, and it is further noteworthy that the Phoenix Co. wished the truss to be 35 ft. deep, and offered to make the price less with it than with a 32-ft. truss.

The point suggests itself: How could the American firms offer to build the bridge in as few weeks as the English firm required months? The reply is simply that their system of bridge-building enabled it to be done. Here the builder gets his drawings from the railway engineer, who designs every rivet and bolt, if he does not specify how the rivet or bolt is to be driven. A. B. wishes one style, C. D. an entirely different type, so that the builder must be prepared for anything—the advocates of the American system might say for nothing. In America, on the other hand, the builder designs the bridge, or rather, he has a standard type, and the engineer only needs to state requirements. The firm can therefore have special machinery for rolling their iron or steel to the standard sections needed, and are thus independent of steel makers. They are, therefore, prepared in the fullest sense of the word. It may be urged that the British system admits of greater choice of design, and therefore suits British needs; but after all it is to the foreigner we, in large measure, have to look for orders, and, as a rule, he is satisfied with what he can get quickly and cheaply, provided it meets the desired conditions as to load and tension and compression tests. We do not enter into the relative value of American and English designs, or as to whether American or British prices are lowest. Our contention is that there are most convincing evidences that the American practice has its advantages. As to relative prices, it is to be regretted that in the case of the 246-ft. span quotations were not got from English as well as American firms; but Messrs Clark's business was not to collect proofs on economic points. Fortunately, however, the idea suggested itself, presumably for other reasons, to get an English firm to quote a price for a 197-ft. span from sketch drawings supplied by an American firm who had tendered, so that we have in this case comparative prices:

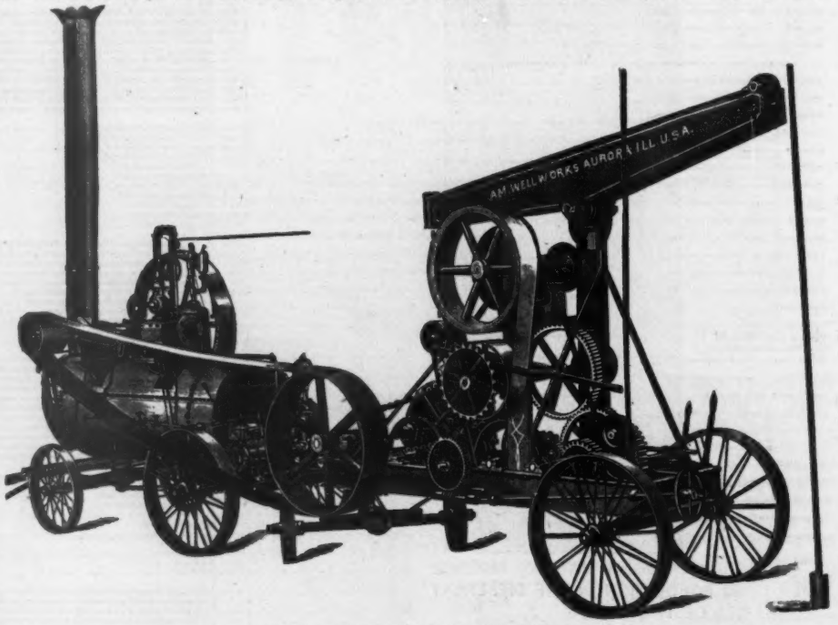
Quotations for 197-ft. Span.

	Price. £.	s.	d.	Weight. tons.	Price per ton £.	s.	d.	Price per lb. cts.
Pencoyd Bridge Co..	1,679	13	0	117¾	14	5	0	3.09
British firm.....	2,025	3	0	138	14	13	6	3.18

It will be noticed that the British firm (which need not be named) assumed a greater weight—that is, in accordance with practice—and that their price per ton was greater, notwithstanding that material and wages are said to be dearer in the States. Of course, The American firms have special machinery. This, however, one may find in almost all concerns.

A CONVENIENT PLANT FOR WELL SINKING.

We illustrated and described in our issue of Aug. 11, 1892, some of the well drilling machinery made by the American Well Works, of Aurora, Ill., and used in sinking the deep well at Galveston, Tex. The accompanying cut shows a complete well drilling plant mounted on wheels for convenient and rapid transportation, and especially adapted for



A WELL DRIVING PLANT ON WHEELS.

driving wells of moderate depth where a considerable number have to be driven over a small area. The churning movement by which the drill is worked is obtained by a set of elliptic gears which raise the drill slowly and drop it very quickly. This causes the drill to strike the rock by what professional drillers call striking on the spring of the rope.

Where soft formations are penetrated a turning engine is used to rotate the pipe and a stream of water is forced down to wash out the borings.

THE USE OF ASPHALTUM FOR RESERVOIR LININGS.

The following is an abstract of a paper by Mr. James D. Schuyler, read before the American Society of Civil Engineers on Dec. 7, as noted in another column.

Experiments in this use have been made in various parts of California, where asphalt is found in a great variety of forms, and seems to be especially adapted for reservoir lining, as it is elastic and does not crack, is insoluble in water or acids, imparts no taste to the water, and is easily kept in repair. The experiments made have been generally successful. At San Buenaventura a circular reservoir 100 ft. diameter and 10 ft. deep, part in excavation in a light, sandy and gravelly soil, and part in embankment, from the material excavated, with slopes of 1 to 1, was paved on bottom and sides with cobble stones laid in mud. Over this a sheet of hot liquid asphalt from 1-10 to ¼ in. thick was spread with brooms. After filling with water, one part of the bank settled 2 ft., but it caused no leak. A small reservoir excavated in shale and soft sandstone was similarly coated, and has now done good service for a year.

The writer built a circular reservoir 64 ft. diameter, 7 ft. deep, with slopes 1 to 1, lined with asphalt ½ in. thick. The first coat was laid in vertical sections 2 ft. wide and was a mixture of 15% of asphalt and 85% of beach sand heated to 300° F., spread with rakes, and tamped with hot irons. The neglect to paint the raw edge of previously laid sections before applying additional ones caused vertical cracks to appear after about a year's use. The repair of these required three days' labor of one man and ½ barrel of asphalt, and no cracks have since appeared. Strips of strap iron were driven into the slope at frequent intervals, to attach the asphalt to the slope, and a second coat, about ⅛ in. thick, of asphalt fluxed with 10% of "mineral tar," heated to a temperature of about 250° F., was applied to the entire surface, and smoothed with hot irons.

This experience led the writer to recommend the use of asphalt in lining two large distributing reservoirs at Denver. The dimensions of these are 350 × 420 ft. and 236 × 580 ft., with depth to flow line, 26 ft. The inner slopes are 1½ to 1. They lie on sloping ground, and were excavated to full depth of 32 ft. on the upper side, and embanked on the lower side. They were mostly excavated in the winter; and a 12-ton steam roller was used to consolidate the banks, the material being sandy loam, clay and shale. A 5-ton slope roller was used on the slopes. For one of the reservoirs, Trinidad asphalt was then applied in a mixture consisting of 20% asphalt mastic and 80% sand. This was hauled 2½ miles in wagons; and if the temperature was below 250° F. on arrival it was rejected. It was laid in horizontal strips 10 ft. wide and 1¾ ins. each, with hot rakes, tampers, etc.; and, while still hot, anchor spikes 1 × ⅜ 7 to 8 ins. long were driven 12 ins. apart each way, alternate rows being temporarily left projecting above the surface, to support strips on which the workman could ascend and descend the slope. A finishing coat was put on (the spikes being driven flush), and finished by smoothing irons heated to a cherry-red, leaving a bright glossy surface. The cost was 14.94 cts. per sq. ft.

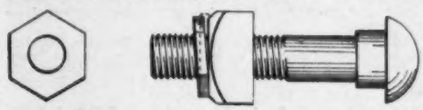
The La Patera asphalt, which was used for the other reservoir, is a rock asphalt from Southern California. The mine is but 100 yds. from the ocean, and the workings now reach 70 ft. below tide level. The material is brittle, not sticky, mines easily, does not melt in the sun, contains about 60% of bitumen, of which 9% is volatile, and costs at the mine $20 per ton. The Las Conchas asphalt used as a fluxing material is from a deposit 30 miles east of the La Patera mine, is richer in oil, and contains about 13% of "fixed" bitumen and 80 % which is volatile at 1100° F. After extracting the asphalt from the sand in which it is found, it is a viscous mass at ordinary temperature and is shipped in barrels. The writer then describes the method of preparing the mastic for coating the reservoir, 78% of the La Patera asphalt to 22% of the

Las Conchas flux being boiled together at a temperature of 250° to 300° F.; 20% by weight of this mastic to 80% of sand was used in the first coat. These were, after mixing, spread with hot rakes, and compressed with rollers made from sections of cast iron pipe in which a hanging fire-basket maintained the heat. A ⅝-in. wire rope pulled the roller, and it was manipulated by about seven men. This method was more satisfactory than tamping. The cost for this reservoir was 13.45 cts. per sq ft. In one of the made banks of the reservoirs just described, a fissure 6 ins. wide and 100 ft. long was repaired at a cost of $20, without drawing the water off. During last winter ice formed 18 ins. thick, when the water stood within 8 ft. of the top, and while it was frozen fast to the lining all around, the water was lowered 4 ft. without injury to the lining.

THE FOUGERE NUT LOCK.

In spite of the great number of nut locks already on the market, they do not seem to so completely fill the bill, nor so completely exhaust the possibilities, but that new designs of nut locks are continually being added and securing a share of patronage. The nut lock invented and patented by Mr. Fougere, of Canada, which we illustrate herewith, is a combination of jam-nut and spring plate. It is very simple, costs about the same as the well known Verona nut lock, and appears to us to be a very serviceable device.

The nut lock is a flat nut having the tap run through at an angle, so that it will run somewhat

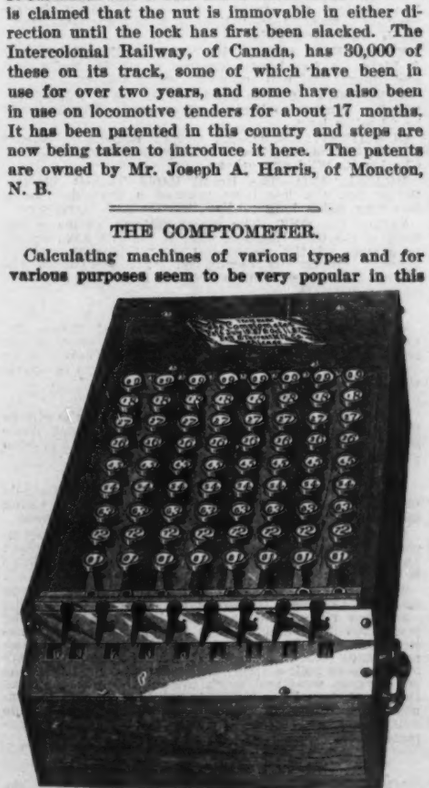


Fougere Nut Lock.

obliquely, as shown, on the thread of the bolt. After the ordinary nut has been screwed up on the bolt, the lock nut is screwed up against it and tightened by a wrench until it lies flat against the ordinary nut, as shown by the dotted lines in the accompanying cut. No injury is done to the thread and the nut lock may be used over and over again. It furnishes also a neat finish for finished nuts. It is claimed that the nut is immovable in either direction until the lock has first been slacked. The Intercolonial Railway, of Canada, has 30,000 of these on its track, some of which have been in use for over two years, and some have also been in use on locomotive tenders for about 17 months. It has been patented in this country and steps are now being taken to introduce it here. The patents are owned by Mr. Joseph A. Harris, of Moncton, N. B.

THE COMPTOMETER.

Calculating machines of various types and for various purposes seem to be very popular in this



The Comptometer.

labor-saving decade, and among the later applications of mechanism to commercial accounting and scientific computation is the "Comptometer" here described.

This is claimed to be a universal calculating machine operated by keys after the manner of a typewriter and it will perform multiplication, division and substraction, will extract the square root, compute interest, etc. The comptometer consists of a series of numeral wheels, each standing for an order of numbers and so arranged that only one of the figures on its periphery can be seen at one time. The bank of keys acts upon these wheels and the answer appears on the register. In capacity it varies from 9 to 17 columns of figures, with dimensions of 14½ × 7½ × 5 ins. Each key has two figures on its head, a large and a small one. To multiply and to add, the large black figures are struck; while for substracting, division, square root, etc., the smaller red figures are used.

The makers of this machine, the Felt & Tarrant Mfg. Co., of Chicago, say that this device has now been in extended practical use for about five years by banks, engineers, insurance companies, railway offices, by the U. S. Coast and Geodetic Survey, the U. S. Signal Bureau, astronomical and meteorological observatories, etc. It is claimed that it saves at least 40% in the work of addition and still more time in the more complex operations of numbers. The price ranges from $125, for the 8-column machine, to $400 for the 16-column computor; the capacities of the registers varying from 999,999,999 to 99,999,999,999,999,999.

The relation between the recent cholera epidemic in Hamburg and the impure water supply of that city is briefly shown by Mr. W. Kuemmel in the "Journal fuer Gasbeleuchtung und Wasserversorgung." Mr. Kuemmel states that during the height of the epidemic 31.04 new cases of cholera and 13.10 deaths per thousand occurred in Hamburg. The city derives its water from the Elbe River, above the city, without filtration. In Altona there were 4.50 new cases and 2.21 deaths per thousand—three-fourths of the total number of cases in Altona were proved to be directly imported from Hamburg. Altona derives its water supply from near the estuary of the Elbe, and below the outlets of the Hamburg and Altona sewers, but has a well-regulated system of filtration.

The average speed of English railway trains, according to their regular schedules, is given in a return issued by the Board of Trade regarding railway communication between London and great towns. The highest average speed attained by the trains on the different lines is as follows: Great Western Ry., 45 miles per hour; London & Northwestern Ry., 47; Great Northern Ry., 51; Midland Ry., 51; London, Brighton & South Coast Ry., 43; Great Eastern Ry., 38; and London & Southwestern Ry., 37.

The quality of the water supply of Baltimore is attracting some attention in that city. Mr. C. W. Chancellor, State Health Officer of Maryland, recently contributed an article to the Baltimore "Sun," in which he states the needs of the city, as follows:

(1). A water supply visibly and actually free from pollution, with a well organized corps of inspectors exercising a constant and thorough surveillance over the entire watershed.

(2). The maintenance of large reservoirs not only for storage purposes, but to allow an opportunity for the dissolved organic matters to oxidize, or be carried by subsidence along with the suspended mineral matters to the bottom.

(3). Effectual filtration of the entire water supply by which a very considerable part, if not the whole, of the extraneous matters will be removed.

That the Pennsylvania Railroad proposes to illuminate its tracks between New York and Philadelphia with electric lights, is a story with many variations, which has been widely circulated in the newspapers lately. The scheme is preposterous on its face, and Chief Engineer Wm. H. Brown informs us that no such improvement(?) is in contemplation. The story probably had its origin in the work now in progress on an electro-pneumatic block signal system, covering a part of the distance between New York and Philadelphia.

Water was admitted to the new four-mile tunnel of the Chicago water-works on Dec. 7. Work was begun on the shore shaft Dec. 1, 1887. The tunnel was described in detail in our issues of July 5, 1890, Sept. 8, 15 and 22, 1892.

A new navigable balloon, with an extraordinarily ligth motor is about to be tested in France, according to reports in foreign journals. About seven years ago Commandant Renard, director of the central establishment of military balloons at Chalais-Meudon, France, and designers of the new balloon made a number of experiments with the dirigible balloon "La France." The new balloon, "Genéral Meusnier," is cigar-shaped, like its predecessor "La France," and measures 70 m. from tip to tip, with a diameter of 18 m. and a capacity of 3,400 cu. m. The car, which is constructed of bamboo and steel, contains a cabin for the machinery and men. The motor employed is worked by means of gasoline and balloon gas, and develops 45 HP. for eight or ten hours. It is expected to drive the balloon at a speed of about 24 miles per hour. The total weight of the machinery, with the carbureter, gasoline, and accessories, will not exceed 1,200 to 1,400 kilos., or 30 kilos. (66 lbs.) per HP. Until now petroleum motors of large size have weighed 5 to 7 times as much, but M. Renard has been able to reduce the figure by some arrangements not disclosed. The screw-propeller is placed in front of the car and the rudder behind. The balloon has been entirely constructed at the Chalais works by engineering soldiers who are studying the art of ballooning. It is expected that the trial ascent will be made during the fine weather in the early part of 1893.

The cost of street sprinkling in Indianapolis and other details of interest are given by Mr. F. A. W. Davis, Treasurer of the Indianapolis Water Co. in a recent communication to the Board of Public Works of that city as follows:

Square feet sprinkled	14,880,964
Gallons of water used	105,515,000
Total cost of water	$7,566
Gallons, per foot used	7.095
Cost per foot, cents	.00568

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

CLEVELAND, WOOSTER & MUSKINGUM VALLEY.—A delegation of citizens from Worcester and Millersburg, O., headed by Mr. James B. Taylor, of Worcester, is in Baltimore to confer with Baltimore & Ohio officers in regard to extending this railway down the Killbuck valley to Millersburg and to the coal fields in the vicinity. The road will then be further extended to connect with the Baltimore & Ohio main line at or near Zanesville, and will have an outlet for coal in both directions. The road from Lodi, on the Akron -Chicago Branch, is already completed and operated to Worcester, a distance of 21 miles. The proposed extensions will carry it to Millersburg, 20 miles, and to Zanesville, 30 miles, giving the Baltimore & Ohio a feeder 71 miles long. The whole route has been surveyed and decided upon. It is proposed to secure the right of way and grade the road, which is then to be turned over to the Baltimore & Ohio absolutely for completion and operation. The delegation has received assurances that the proposition will receive favorable consideration by the Baltimore & Ohio officers. The road from Lodi to Worcester was built by Ryan & McDonald.

SANDUSKY & COLUMBUS SHORT LINE.—This railway from Sandusky, O., south to Columbus, O., 108 miles, has been completed, the last spike being driven Dec. 4. Ballasting is now in progress and the road will soon be ready for business.

MILWAUKEE & GRAND RAPIDS.—Construction is being rapidly pushed on this line from Belding, Mich., west via Grand Rapids to Grand Haven, Mich. The right of way has all been secured, the roadbed partly graded and the cross-ties delivered. The company has about 1½ miles of water frontage at Grand Haven.

LITTLE FALLS & DOLGEVILLE.—This 11-mile railway from Little Falls to Dolgeville, N. Y., has been completed and turned over to the company which will at once put on a regular schedule of trains. The road is unusually well built for a new line, having 60-lb. rails, oak and Georgia pine cross-ties, and broken stone ballast. The contractors were Godeffroy & Howe, of New York city.

NEW YORK, NEW HAVEN & HARTFORD.—This company proposes to issue $15,000,000 of convertible debenture certificates, the proceeds of which are to be used for the following purposes: For the completion of four tracks on the New York division, including the Harlem River branch; for the completion of two tracks between New Haven and New London; for terminals, notably at Providence, New London, New Haven, Bridgeport and New York; for additions to the company's motive power and equipment, an extension of its block signal system, and the elimination of grade crossings; for the payment of the public debt of the company already incurred for the above purposes.

TOLEDO, WALHONDING VALLEY & OHIO.—The section of this line from Londonville to Coshocton, O., 46 miles, has been completed with the exception of ballasting. Trains will begin to run on Jan. 1, 1893.

WASHINGTON & CHESAPEAKE BEACH.—The contract for building this proposed railway from Washington, D. C., to the Chesapeake Beach, 30 miles, has been let to Godeffroy & Howe, of New York city. Ch. Engr., L. H. Hyer, Washington, D. C.

LAKE SHORE & MICHIGAN SOUTHERN.—A report is in circulation that this company will probably build a branch from a point near Stoneboro, Pa., to Grove City, to open up coal lands in Mercer Co., Pa.

Projects and Surveys.

AKRON & NEW CASTLE.—A railway company by this name has been chartered in Ohio. The capital stock is $50,000.

HANCOCK & STATE LINE.—Chartered in Pennsylvania to build a railway from Hancock, N. Y. to the Pennsylvania State line. Pres., Nathan C. Bundy, Philadelphia, Pa.

LAKE HOPATCONG, BOONTON, MORRISTOWN & NEW YORK.—It is stated that the construction of this railway from Caldwell to Rockaway, N. J., 15 miles, with 6 miles of branches, depends entirely upon the success in securing the right of way. Surveys are now in progress between Rockaway and Parsippany. Engr., C. C. Vermeule, 71 Broadway, New York city. Secy., H. C. Raynolds, Whippany, N. J.

ORANGEVILLE & LEHIGH.—Chartered in Pennsylvania to build a railway from Orangeville to Houser Mill, Pa. Pres., Rudolph T. McCabe, New York city.

PHILADELPHIA & WILLISTOWN.—J. G. Allen, 1237 Spruce St., Philadelphia, Pa., is President of this company whose incorporation was noted last week.

Southern.—Existing Roads.

TREDGAR MINERAL.—The prospects are that work will soon be commenced on an extension to Burke Iron Mt., Ala., about 4½ miles. Geo. H. Montgomery, Jacksonville, Ala.

CARRABELLE, TALLAHASSEE & GEORGIA.—It is expected that work will be resumed on this railway from Carrabelle, Fla., to Thomasville, Ga., some time in January, 1893.

FLORIDA CENTRAL & PENINSULAR.—This company has sold $2,000,000 of bonds to secure money to build its proposed connection from Hart's Road to Savannah, Ga., 132 miles. The contract has already been let to the Southern Supply Co., of Atlanta, Ga. Work is now in progress, and it is expected to have the line completed in September, 1893. There will be steel bridges over the Altamaha, Satilla, Ogeechee and St. Mary's rivers, and steel rails weighing 70 lbs. per yard will be used.

MILLEN & SOUTHERN.—There is talk of soon commencing an extension from Stillmore to Lyons, Ga.

MOBILE & OHIO.—It is announced that this company has secured control of the partly graded Montgomery, Tuscaloosa & Memphis R. R., running from Montgomery to Tuscaloosa, Ala., 107 miles, and will make some changes in the route and complete it. As now surveyed the line runs from Montgomery via Maplesville to Centerville and thence to Tuscaloosa. According to the present report, this line will be changed at Centerville to run north to Blocton, and thence to Tuscaloosa, and from the last place continued to Columbus, Miss. Surveys are reported in progress on these proposed lines.

OWENSBORO, FALLS OF ROUGH & GREEN RIVER.—This company has given a mortgage to the Metropolitan Trust Co., of New York city, for $6,000,000 of bonds. The proceeds are to be used as noted in our issue of Nov 24, to build an extension to Middlesborough, Ky.

DECATUR, CHESAPEAKE & NEW ORLEANS.—This railway projected to run from Gallatin, Tenn., to Aberdeen, Miss., about 250 miles, of which about 85 miles were completed in 1889, is to be sold at auction on Dec. 31.

JACKSONVILLE, ST. AUGUSTINE & INDIAN RIVER.—It is stated that if the right of way can be easily obtained the proposed extension from Rockledge to Melbourne, 24 miles, will be built this winter, but if not it is doubtful if the work will be done for some time.

Projects and Surveys.

RICHMOND & CHESAPEAKE.—It is stated that the contractors, Mason, Hodge & Co., are making arrangements to begin work on this line from Richmond to Wicomico, Va., about 50 miles. The work includes a tunnel about ¼ mile long at Richmond.

ILLINOIS, KENTUCKY & VIRGINIA.—A correspondent writes us that the stockholders of this company will hold a meeting in East St. Louis, on Dec. 8. Parties interested are Messrs. McCaseland, Griffin, Townsend, Strong, Parklin, Johnston, Dobbin, Kearns, Little, McKaw, Dunkline. They have complete survey from St. Louis, Mo., to Norfolk, Va. The heaviests grade is 52 ft. per mile, and the sharpest curve 10°, and over half the line is less than 26 ft. per mile with long tangents and light curves. The total distance is 987 miles.

WEST VIRGINIA SOUTHERN.—Chartered in West Virginia to build a railway from a point at or near Hulings up Cheat River and the Dry Fork of that river to a point at or near the mouth of the Glady Fork of the Dry Fork of Cheat River, at the junction of said Glady Fork and Dry Fork in Tucker Co., with a branch from a point at or near the mouth of Otter Fork of Dry Fork of Cheat River, running thence by the most practicable route up the said Otter Fork to a point at or near Alpena, in Randolph Co. The capital stock is $50,000.

EDISTO ISLAND.—A bill has been introduced into the South Carolina legislature to charter a railway by this name.

CHESTERFIELD & KERSHAW.—A bill has been introduced in the South Carolina legislature to amend the charter of this company in relation to the subscription of bonds to the capital stock, and to authorize the company to build a branch road to Sumter.

Northwest.—Existing Roads.

CHICAGO, ROCK ISLAND & PACIFIC.—The line from Lincoln to Jansen, Neb., is rapidly approaching completion.

PEORIA TERMINAL.—The contract for building this 6-mile railway from Peoria to Bartlett, Ill., has been let to Gillman & Earl, of Marshalltown, Ia.

CHICAGO & NORTHWESTERN.—Surveys are reported commenced on the long projected extension from Princeton to Necedah, Wis., and it is stated that the line will be built soon.

DULUTH, & IRON RANGE.—This company has let the contract for a new ore dock 2,000 ft long, at Two Harbors, Mich. It will have 232 pockets, with a capacity of 45,000 tons. Extensions of the old ore dock at the same place are to be made also.

CHICAGO.—A press dispatch from Chicago, dated Dec. 3, says: "Negotiations for one of the biggest local railroad and real estate deals in which Chicago has ever been interested are in progress, and if carried through will practically revolutionize the traffic of the city. The deal involves the transfer of the Stickney tract. Representatives of the moneyed interests in the Chicago roads from the East have been here taking part in the deliberations. Reasons urged on the Chicago railroads for going into the scheme are that it is absolutely necessary for them to establish some sytem of transfer of through freight outside of the city limits; that the adoption of the plan proposed would do away with 50% of the switching now done within the city, effecting a saving of not less than $200,000 annually to each road in Chicago; that the blockades from which the roads periodically suffer to an ever-increasing extent would be entirely avoided, and that much time would be saved in the transportation of freight and the use of cars. By the establishment of warehouses at the Stickney tract, as is now proposed, merchandise consigned to Chicago wholesale merchants to be sold and reshipped by them would never have to be brought into the city at all."

Projects and Surveys.

PUEBLO & DULUTH.—In regard to this proposed railway from Sioux City, Ia., to Pueblo, Colo., about 900 miles, the Ponca, Neb., "Journal" says: "We learn from W. E. Holmes, who visited Neligh a few days ago, that the Pueblo & Duluth R. R., the headquarters of which are at Neligh, Neb., is likely to be commenced in the spring. Instead of being given up or dead, the enterprise never showed more vitality and earnestness of purpose than it does now. The company has a large office at Neligh in which several men are busy preparing profiles, estimates, etc. Mr. D. H. Hitchcock, the President of the road, is now in New York making final negotiations with the capitalists. The line is now surveyed and profiles made of the same from Sioux City southwest to the west line of the state. Neligh voted $125,000 to the company to make that place the end of a division."

Southwest.—Existing Roads.

FT. WORTH & RIO GRANDE.—The report that this line will be extended south from Brownwood, Tex., noted in our last issue, is said to have been confirmed. Construction will begin immediately for a connection with the Southern Pacific and the Mexican International at Spofford Junction. The line will be extended this winter to either Menardville, Menard Co., or to Junction City, Kimble Co. Preliminary surveys will be run to each place, and the route which the road will take is not to be determined by the bonuses which towns may donate but by the cost of construction. Whichever route can be built cheapest will be adopted by the company. The latter route is considered the most desirable, running, as it does, on a nearly direct line from Brownwood to Spofford Junction.

TEXAS, LOUISANA & EASTERN.—This line has been graded as far as Cleveland, Tex., east of Conroe, Tex., and tracklaying will be commenced at once.

NEW ORLEANS & NORTHWESTERN.—Gen. Man., W. D. Jenkins, Natchez, Miss., is reported as saying that the extension from Rayville to Collins, La., will probably be constructed in 1893.

NATCHITOCHES.—The contract for tracklaying on the 4-mile extension to Grand Encore, La., on the Red River, has been let to Green & Brogan, of New Orleans, La.

ST. LOUIS & SAN FRANCISCO.—It is rumored that this company is making preparations to begin the construction of an extension from Ozark to Little Rock, Ark.

Rocky Mt. and Pacific.—Existing Roads.

COLUMBIA & PUGET SOUND.—Tracklaying is now practically completed on the extension from Maple Valley, via Sherwood City, to Maple Leaf, Wash., 9 miles.

COLORADO MIDLAND.—Gen. Man., H. Collbran, is quoted as saying: "We are now negotiating for the rolling stock for our line to Cripple Creek. If we have an average winter the road will be running into Cripple Creek by Feb. 1, 1893. About three-fourths of the grading has been done between the divide and Midland, and about one-half the work between Midland and Cripple Creek. The most of the ties have been secured and are on the ground. The rails for our road to Cripple Creek are being made at the Bessemer Works, Pueblo. The most important contract now to be let is for the rolling stock, and negotiations are pending for that. The work is being pushed rapidly and we hope to continue making the same rapid progress. If the weather should not seriously interfere, the new railroad will be running into Cripple Creek by Feb. 1. Everything is moving along in good shape, and from the present outlook, there will be no cause for delay."

SANTA FE, PRESCOTT & PHOENIX.—At the recent annual meeting of the stockholders of this company, the following officers were elected: Pres., D. B. Robinson; Vice-Pres. and Chf. Engr., G. W. Vaugh; Secy., F. M. Murphy, and Treas., E. M. Dickey. It is expected to have the section from Prescott to Ash Fork, Ariz., completed by Feb. 1.

BUTTE, ANACONDA & PACIFIC.—An official of the company is reported as saying: "We have the right of way secured and paid for from Butte to the city of Anaconda. About 700 men are now at work at different parts of the route, and working with all the expedition that the weather will permit. A grading party of about 100 has just established winter quarters at Silver Lake, 16 miles west of Anaconda. An engineering party has just reached Hamilton after making a preliminary survey from Philipsburg across the Bitter Root range. Joe Carroll, one of the tie contractors, is now delivering ties at Silver Bow. Kenney & Nuss have established a tie camp at the head of Douglass Creek, near the Hellgate River. All tie contracts are to be completed by Feb. 15. Barring very severe weather and accidents there is no reason why trains should not be running between Butte and Anaconda by April 15, 1893."

BURLINGTON & MISSOURI RIVER.—The completion of the Northwestern extension to Sheridan, Wyo., and work on a further extension to the Tongue River have given rise to a flock of rumors concerning the further continuation of the line into Montana. According to the Montana papers, the company's surveyors have been running lines through Montana, starting from Sheridan and working in a general way toward Billings, thence toward Great Falls, either by way of White Sulphur Springs and Castle, or going in a northerly direction from Billings to the Musselshell River, along the course of that stream and its tributaries by the best passes obtainable to the branch of the Great Northern already in operation to Neihart, from Great Falls. The surveyors have observed the strictest secrecy as to what engineering difficulties they found along this projected route, though there are generally supposed to be some that are almost insurmountable. Still another projected route runs north from Billings, keeping clear of the mountains and running along the bench lands of Fergus Co., bearing to the northwest and striking the Great Northern at Benton. This latter route would have only the stock business to draw upon, and the opinion of the best informed is that when the Burlington leaves the Yellowstone River, at a point near Billings, it will make for the mines of Meagher Co. and the smelters at Great Falls. Should it be built to White Sulphur Springs and Castle, it would meet at these points the new projected Helena, White Sulphur Springs & Castle road, which is confidently expected to be built next year. This would bring the line practically into Helena. The great difficulty lies in the fact that there is a big range of mountains between White Sulphur Springs and Neihart, at which place it would meet the branch of the Great Northern. It is not known whether or not the surveyors found a way around, over or through these mountains. As the crow would fly from Billings to Great Falls, there is much broken, hilly and mountainous country and only a careful survey would disclose its opportunities for a line of railway. Between Sheridan, Wyo., and Billings, Mont., the engineers have found a comparatively easy route. The line will run from Sheridan west to Pass Creek, along that stream to its mouth, along the Little Big Horn to Fort Custer, from Fort Custer nearly due west to Fly Creek, along Fly Creek to the Yellowstone River, at Pompey's Pillar; west along the Yellowstone to a desirable point for branching to the northwest, probably at Alkali Creek, about 15 miles east of Billings. Besides being a very feasible route, it is stated that the road can be built for $1,250,000 less than over any of the other proposed routes. Some surveying has been done northwest of Great Falls, and as there is almost an empire there not traversed by a railway it is thought the Burlington may take a northwest direction from Great Falls and meet the Pacific extension of the Great Northern at the eastern side of the main range of the Rockies. It is confidently believed that as soon as construction work is possible in the spring the Burlington will be laying track across the Crow reservation, and that within one year it will have trains running into Helena and Great Falls.

Projects and Surveys.

VICTORIA & SIDNEY.—It is stated that this company has sold its bonds in England, and will at once begin the construction of its line from Victoria to Sidney, B. C., 18 miles. Ch. Engr., E. G. Tilton, Victoria, B. C.

MT. VERNON, BAYVIEW & NORTHERN.—Organized in Washington to build a railway from Mt. Vernon to Edison, Wash., 15 miles. Ch. Engr., A. H. Allerton, Mt. Vernon, Wash.

SAN FRANCISCO & SALT LAKE.—It is reported that surveys will be resumed from the California-Nevada line east, early in January.

ELECTRIC RAILWAYS.

ITHACA, N. Y.—The electric railway company has sold out to a syndicate of Scranton, Pa. A power plant of 1,200 HP. will be driven by water power from Fall Creek.

WAVERLY, N. Y.—The Interstate Traction Co. has been organized to build an electric railway to the Pennsylvania state line. Capital stock, $20,000. Among the directors are J. T. Sawyer and J. B. Floyd, of Waverly, N. Y., and J. H. Torrey, of Scranton, Pa.

JERSEY CITY, N. J.—Jersey City, Hoboken & Rutherford Electric Ry. Co.; $300,000; H. B. Hyde and L. Fitzgerald, of New York, N. Y., and C. H. Russell, Brooklyn, N. Y.

PITTSBURG, PA.—The Allegheny Traction Co. has decided to adopt electric traction.

MARIETTA, PA.—Marietta & Maytown Electric Street Ry. Co.; capital stock, $24,000, with $4,800 paid in; Pres., Amos Bowman.

PHILADELPHIA, PA.—Schuylkill Valley Electric Street Ry. Co.; to build a line from Philadelphia to Phoenixville; capital stock, $50,000, with $10,000 paid in; Pres., Geo. F. Peirson.

NEW ORLEANS, LA.—The northern syndicate which has acquired the street railways will adopt electric traction. Pres., Jesse Seligman, New York; Gen. Man., M. J. Hart, New Orleans.

VICKSBURG, MISS.—The Vicksburg Electric Transit & Light Co. has been organized by C. R. McFarland and others, and will commence work shortly.

SANDUSKY, O.—The Sandusky, Huron & Milan Electric Ry. expects to begin grading soon. The line will be 22 miles long.

CUMMINSVILLE, O.—An electric railway to Burnet Woods, Clifton and Cincinnati is projected by S. C. Cox, Charles R. Wild and others.

BRAZIL, IND.—The Brazil Rapid Transit Electric Street Ry. Co. has been granted a franchise for a line four miles long to Knightsville and Harmony.

TORONTO, ONT.—The street railway company has notified the City Engineer that it intends next season to change all the routes left over this year, and to operate entirely by electricity. This will mean the repaving of some 30 miles of track next year at a cost of over $300,000.

ELEVATED RAILWAY.

CHICAGO, ILL.—The Chicago General Street Ry. Co. has been incorporated, with a capital stock of $3,000,000, and proposes to build an elevated belt line for the joint use of the several electric railways in operation in the suburbs.

HORSE RAILWAY.

CLEVELAND, O.—A project is on foot for the city to build a double track line to Gordon Park and Wade Park, and lease it for operation. The matter has been put before the Mayor.

HIGHWAYS.

NEW YORK.—On Dec. 21 the people of New Rochelle will hold a special election for the purpose of voting upon the question of raising $50,000 for road purposes.

MASSACHUSETTS.—The Board of Road Commissioners at Clinton proposes to put in a stone crushing plant and to use stone instead of gravel for the roads. There is said to be suitable stone very near at hand.

MISSOURI.—A project for a road from St. Joseph to Lake Contrary is before the County Court. The court has viewed the route and has expressed to the gentlemen interested a desire to construct a macadamized driveway from the city to the lake as soon as the county can provide the funds necessary. Private owners have built a strip of macadamized road from the stock yards west and south toward the lake, and the County Court will endeavor to establish a road to connect with the same. About $6,000 to $8,000 a mile will be required to construct the road that is contemplated.

WATER-WORKS.

New England.

MEREDITH, N. H.—Surveys and plans for works are to be made for the precinct.

BRATTLEBORO, VT.—A village meeting has been called for Dec. 20 to appoint a committee with power to employ an engineer to report on a village water supply. An individual now owns works here.

LOWELL, MASS.—The Council has ordered a loan of $100,000 for a driven well plant, including a pumping station and force main.

MELROSE, MASS.—The Legislature will be petitioned for authority to take water from Great Pond, North Andover, for a new supply. It is hoped that Malden and Medford will join with Melrose in conducting the water of Great Pond to Spot Pond, some 17 miles. Spot Pond now supplies the three towns named.

ROCKPORT, MASS.—The Selectmen have petitioned for authority to build works. Address H. H. Woods or J. B. Donahue.

SALEM, MASS.—The officials are talking of increasing the supply by raising Newham Lake, and drawing water from adjacent ponds and Ipswich River.

UXBRIDGE, MASS.—The legislature has been petitioned for authority to introduce water from Mendon Pond or other sources within the town limits, as an additional supply. Estimated cost, $100,000. Engr. P. M. Blake, Hyde Park, has reported on the subject.

ROCKVILLE, CONN.—The taking of water from Snipsic Lake for domestic and fire purposes has been indefinitely postponed by the voters.

Middle.

ALBANY, N. Y.—The Water Board has reported to the Council recommending a new supply from Kinderhook Creek. Engr. Geo. Yost estimates the cost at $1,486,505 and Consult. Engrs. Clemens Herschel and J. J. R. Croes, at $1,600,000, for a daily supply of 20,000,000 gallons. Three reservoirs and a pipe line are proposed.

NEW YORK.—The firm of G. N. Cowan & Co., Stamford, expects to build works at Richmondville, N. Y., in the spring, and has franchises for works at Bliss, Cassadaga and Panama.

ALTOONA, PA.—Bids are wanted until Dec. 15 for constructing an impounding reservoir on Burgoon's Run, just below the present storage reservoir. C. A. Martin, Secy., Bd. Water Comrs.

BELLWOOD, PA.—The Borough Council is investigating the building of works.

BLOOMSBURG, PA.—The Manufacturers' Water Co. has been incorporated; $1,000; Treas., C. C. Peacock.

GIRARD, PA.—It is reported that the borough will vote on building works.

HAZEL, TOWNSHIP, LUZERNE CO., PA.—The Gravel Run Water Co. has been incorporated; $5,000, $500 paid in; Treas., Arthur Haviland, Philadelphia. Water will be supplied near Hazleton.

LOCK HAVEN, PA.—The Council has under consideration a survey for a new supply from Queen's Run made by Engr. W. P. Mitchell. A 12-in. supply main about 4½ miles long and a reservoir are proposed.

McSHERRYSTOWN, PA.—Works are again projected.

MAHANOY CITY, PA.—Dec. 20 the people will vote on building works. The present supply is furnished by a company.

MILNESVILLE, PA.—The Milnesville Water Co. has been incorporated; $2,500, $500 paid in; Treas., Chas. S. Mason.

NEW WILMINGTON, PA.—The contract for works has been awarded to Chandly Bros., Beaver Falls.

Southern.

DAVIS, W. VA.—It is reported that the citizens have voted for works.

YORKVILLE, S. C.—It is reported that the city has authority to build works, and wishes to correspond with contractors. T. F. McDow, Mayor.

LEXINGTON, KY.—Press dispatches state that a committee has been appointed by the Council to report on an increased supply. It is said that the company's supply is now very low.

North Central.

ASHLAND, O.—Works are talked of. C. W. Coon has made a proposition.

SHREVE, O.—Engr. J. L. Eberhardt has made plans for works with a supply pumped from a spring to a reservoir, with 4 and 6-in. mains and fire hydrants, estimated to cost $12,000.

FAIRMOUNT, IND.—It is reported that the Town Council will take steps to secure water and electric lighting plants.

LEBANON, IND.—W. R. Reed, representing Chicago parties, has been looking up the possibilities for a franchise for water and electric lighting plants.

PORT HURON, MICH.—The city has awarded a contract to the Holly Mfg. Co., of Lockport, N. Y., for a Gaskill high duty pumping engine of 12,000,000 gallons' daily capacity. The price is reported as $41,000.

CHICAGO, ILL.—It is reported that the city engineer has been instructed by the Council to prepare plans for extending the two-mile breakwater tunnels 4½ miles into Lake Michigan.

ROCKLAND, ILL.—Bids for constructing a 1,000,000-gallon covered reservoir are wanted until Dec. 15. F. G. Hoagland, Cy. Clk.

Southwestern.

ST. LOUIS, MO.—High service pumping station No. 3, with two pumping engines is proposed; estimated cost, $220,000.

AUSTIN, TEX.—It is said that the company is considering the addition of a pump.

LOTT, TEX.—It is reported that works are wanted.

CRIPPLE CREEK, COLO.—It is reported that on Dec. 6 the Trustees of the town of Fremont granted a franchise for works to J. A. Jones, who represents the Michigan Pipe Co., Bay City, Mich.; also that a similar franchise will be "granted by the Board of the upper town." Water will be obtained from Beaver Creek and the works must be in operation by April 15.

Pacific.

BALLARD, WASH.—Jan. 7 the people will vote on issuing $71,000 of bonds for water and electric lighting plants.

GLOBEVILLE, COLO.—The Globe Water Co. wishes a franchise.

LOS ANGELES, CAL.—The Council wants, or probably will soon want bids for $526,000 5% water bonds, recently voted to build works to supply the hill portions of the city.

ELLENSBURG, WASH.—The Ellensburg Water Supply Co. has been incorporated; $75,000. A company built works in 1888.

MONROVIA, CAL.—The people have voted to issue $30,000 bonds for an additional water supply for domestic purposes and irrigation.

Canada.

ORILLIA, ONT.—Bids for extensions and improvements are wanted until Dec. 24. C. E. Grant, Town Clk.

ALBERNI, B. C.—It is reported that Messrs. Drake, Jackson & Helmcken intend to incorporate a company to build works here.

ARTESIAN WELLS.

LOWELL, MASS.—A driven well plant will be put in.

IRRIGATION.

NEW COMPANIES.—Green River Land & Canal Co., Granger, Wyo.; $5,000,000; W. W. Porter, Denver; Oliver Olsen, Rock Island, Ill.; Geo. A. Crofutt, Granger, Wyo., and others. Santa Clara Valley Water Co., Campbell, Cal.; $30,000; J. A. Hamilton, S. A. Moulton and others. Central Utah Land & Irrigation Co., Salt Lake City, Utah; $1,000,000; W. H. Rowe, Pres.; Frank Knox, Secy. and Treas.

SEWERS.

BOSTON, MASS.—Bids will soon be asked for the construction of a sewer in the Villa St. extension, in the Roxbury district. The sewer is to be brick, 30 × 41½ ins., and will empty into the metropolitan main sewer in the Back Bay fens. The construction of the sewer will require the driving of 700 piles for a foundation.

LYNN, MASS.—At a meeting Dec. 6 the Board of Aldermen appropriated $20,000 for sewers in Boston, Tudor and Lewis Sts.

MEDFORD, MASS.—The Selectmen will open bids Dec. 17 for a sewer across Mill Pond. Specifications may be seen at the office of Gilbert Hodge, C. E., 19 Exchange Place, Boston.

MELROSE, MASS.—The Committee on Sewerage has engaged W. C. Stevens, C. E., to prepare plans.

NEWTON, MASS.—A sewer will be built from the starch works and adjoining territory to connect with the metropolitan main sewer. About 1,000 ft. of extra pipe will be required.

WALTHAM, MASS.—The Sewer Commissioners will receive bids until Dec. 21 for building a sewer from Linden St. to the State School for the Feeble Minded, pipe, brick, etc., to be furnished by the contractor. Sewer bonds for $50,000 have been sold and others will soon be offered for sale.

STOCKBRIDGE, MASS.—An engineer has been engaged to prepare plans and estimates for a system of sewerage.

WARREN, R. I.—The question of a town system of sewerage is being discussed.

HERKIMER, N. Y.—Plans and estimates for a system have been prepared by F. K. Baxter, Utica. The estimated cost is $35,000, and a special election was called for Dec. 13 to ascertain the sentiment of the taxpayers on the question.

JAMESTOWN, N. Y.—At a meeting of the Common Council Dec. 5 it was voted to rescind the call for a special election on the sewer question, which we noted last week, as to be held Dec. 15.

NEWBURG, N. Y.—At a meeting of the Common Council Dec. 6 an act was adopted for presentation to the next legislature, authorizing the city to construct a sewer from a point near the mouth of the Quassaick Creek to one at Haines' cross-road, West Newburg.

ROCHESTER, N. Y.—The East Side Trunk Sewer Commission will receive bids until Dec. 21 for section 7 of the trunk sewer.

MONTCLAIR, N. J.—It is reported that work will commence on the sewerage system by March 1. Specifications on which contractors can bid are now being prepared.

ROSELLE, N. J.—The Township Committee will receive bids until Jan. 7 for the sewer noted in our issue of last week.

ALLENTOWN, PA.—The Council has directed the Board of Health, with the assistance of the City Engineer, to examine into the feasibility of establishing a complete sewer system in this city, with probable cost, and to ascertain to what point or locations to deposit or drain the refuse without creating a nuisance.

CHESTER, PA.—Bids are being received for certain sewer work.

ERIE, PA.—In the annual report of Geo. Platt, Cy. Engr., just completed, he states that 1.48 miles of sewers have been built, including 12 to 18-in. tile sewers, a 36-in. and a 48-in. brick sewer; and that 6,397 ft. are under construction.

LEWISTOWN, PA.—The question of a system of sewers is being agitated again, and a firm from Huntingdon has asked permission to use the streets for the purpose of constructing a system.

PHILADELPHIA, PA.—The Director of Public Works will receive bids until Dec. 23 for the following work during 1893: Repairing and cleaning sewers, drain pipes, etc.; furnishing cement, terra cotta pipe, iron gutter-plates, etc.; constructing brick, stone and wooden drains, etc.

PHILADELPHIA, PA.—The Councils have ordered main sewers in several streets, and appropriated $85,000 for their construction.

TYRONE, PA.—The question of a sewerage system is being considered, and at the February election the citizens will vote on the issue of bonds for $10,000 for this purpose.

HAGERSTOWN, MD.—Owing to the difficulty encountered in securing the right of way, the Lewis-Mercer Construction Co., New York, has abandoned the proposed construction of a sewerage system in this city.

ROANOKE, VA.—The Board of Public Works will receive bids until Dec. 23 for sewers in several streets, terra cotta pipe to be furnished by the city.

WARREN, O.—We are informed by E. P. Dicky, Cy. Engr., that the proposed Red Run sewer, about two miles of 24-in. pipe, is still in a state of abeyance owing to legal proceedings.

MINNEAPOLIS, MINN.—The city contemplates the following improvements next year, according to the report of the City Engineer: 10 miles of water mains, to cost $86,203; 6 miles of sewers, $105,664; 4½ miles of paving, nearly all with cedar blocks, $86,185; and over 4 miles of curb and gutter, $16,877. There will be 34 sections of sewer work, 30-in. and smaller to be constructed.

KANSAS CITY, MO.—The contract for the Pryor section of the O. K. Creek sewer, which we noted Oct. 27 as awarded to Wm. Taylor at $29,969, was again awarded Dec. 6, this time to Chas. Sebestedt & Sons at $29,141. Wm Taylor bid $29,969 and B. P. Wickham, $29,631. The itemized prices of the contract will be published next week.

DENVER, COLO.—The Board of Public Works has issued a report on public improvements in which the total cost of sewering, grading, curbing and paving the city is estimated to approximate $4,000,000.

GLENWOOD SPRINGS, COLO.—The City Council has been petitioned to take action toward the construction of a system of sewerage.

TYLER, TEX.—The City Council has accepted a proposition for the construction of a system of sewerage to cover 28 blocks in the principal part of the city. Work will begin at once.

OAKLAND, CAL.—At an election last month the citizens of Fruitvale voted to organize a sewer district under the provisions of the new law, which enables a district not incorporated as a city or town the same or greater advantages than those enjoyed by cities in respect to the construction of sewers. There will be over 33,000 ft. of 6 to 18-in. main pipe sewer, and the estimated cost of this is $25,000, for which amount bonds will be issued. J. H. W. Riley is president, and C. D. Bennett, secretary of the newly organized Sewer Board.

STREETS.

BROCKTON, MASS.—The plans of F. H. Snow, Cy. Engr., for the proposed West St. boulevard include the straightening and widening of the present street to a width of 150 ft., for a distance of about one mile. The boulevard will have two 12-ft. sidewalks, two 40-ft. driveways, a 20-ft. center space for flowers, etc., two 8-ft. roadways for electric cars, and two 5-ft. grass plots with trees. The estimated cost of the boulevard is $54,000, and of land damage, etc., $16,000.

LYNN, MASS.—Both branches of the city government have voted in favor of laying out and constructing an extension of Goodridge St., between Chatham and New Chatham Sts. The City Engineer has been directed to prepare plans for laying out Sheridan St.

BROOKLYN, N. Y.—The Commissioner of City Works will receive bids until Dec. 22 for paving one street with asphalt, and until Dec. 23 for paving two streets with cobble-stones.

BUFFALO, N. Y.—The Department of Public Works will receive bids until Dec. 24 for paving six streets with German rock asphalt, Trinidad Lake asphalt, Medina dressed block stone, or brick.

NEW YORK, N. Y.—The Commissioner of Public Works will receive bids until Dec. 20 for taking up and relaying pavement in eight streets.

SYRACUSE, N. Y.—The Highways Committee has been directed by the Council to advertise for bids for paving certain streets with Trinidad street asphalt.

EASTON, PA.—We are informed by H. R. Fehr, Cy. Engr., that the city intends to pave two streets, 7,250 sq. yds., next summer with vitrified brick on a 6-in. concrete base.

ERIE, PA.—We are informed by Geo. Platt, Cy. Engr., that ordinances have been passed authorizing the construction of about 2½ miles of brick pavement this year. About ¾ mile of asphalt paving has been laid. The city now has 14.84 miles of paved streets.

PHILADELPHIA, PA.—The Common Council recently investigated the street paving in New York, especially those streets paved with asphalt upon Belgian blocks and rubble pavement. The investigations are reported to have been satisfactory. The Director of Public Works will receive bids until Dec. 23 for the following work during 1893: Furnishing crossing, gutter and tramway stones, brick, sand, etc.; grading and repairing streets; and for the maintenance of unpaved and macadamized public highways.

CINCINNATI, O.—The Board of Administration will receive bids until Jan. 7 for the construction and repair of all freestone flag sidewalks, for one year. The city is divided into two sidewalk districts.

DAYTON, O.—The City Council has voted to pave Perry St., between Third and Fifth Sts. The estimated cost is as follows: First class Medina block pavement, $15,682; Hayden block, $12,420; Hallwood block, $12,420; asphalt, $12,805; fire or red brick, $11,295; sewers, catch basins and culverts, $350.

HAMILTON, O.—The City Clerk will receive bids until Dec. 20 for improving two streets by curbing, guttering, etc.

WARREN, O.—We are informed by E. P. Dicky, Cy. Engr., that the city has declared its intention to take up about 25,000 sq. yds. of stone pavement and relay with brick on concrete foundation.

INDIANAPOLIS, IND.—The Board of Public Works will receive bids until Dec. 21 for five contracts for grading, gravelling, constructing brick sidewalks, etc.

CHICAGO, ILL.—Superintendent Burke says that an appropriation of $100,000 is necessary for street work this winter.

NEBRASKA CITY, NEB.—We are informed that the public improvements during 1892 have been confined almost exclusively to street paving. Between $60,000 and $75,000 have been expended in this work, and it can hardly be finished this season. The material used is brick of home manufacture.

ST. LOUIS, MO.—The Board of Public Improvements will receive bids until Dec. 27 for six contracts for grading and paving alleys, paving one street with telford pavement, two with Trinidad Lake asphalt, and one with granite blocks.

OKLAHOMA CITY, OKLA.—The question of paving the principal streets is being discussed.

OGDEN, COLO.—The City Council is considering an ordinance for the issue of improvement bonds for $50,000, the greater part of which it is thought will be spent in a park.

CORONADO, CAL.—The Town Trustees have taken action toward paving Orange Ave., a distance of 1½ miles, with cement, gravel and concrete sidewalks, at an estimated cost of $44,000. Bonds will be issued to pay for the work.

OAKLAND, CAL.—The Board of Public Works will receive bids until Dec. 20 for the continuation of the stone embankment of the boulevard around Lake Merritt. Separate bids will be received for 20,000, 40,000 and 60,000 cu. yds. of stone. This work was re-

ferred to more fully last week, and the call for bids for the dredging of the lake is noted elsewhere in this paper.

PORTLAND, ORE.—A petition is being circulated to have Union Ave. paved with asphalt, between East Oak St. and Sullivan's Gulch.

ELECTRICAL.

YARMOUTH, ME.—A company is being organized under the old charter of the Yarmouth Mfg. Co. for the purpose of furnishing electric lights and power to this city and Freeport. A part of the stock is already subscribed, and work will be begun as soon as the balance is taken.

ROCKVILLE, CONN.—At a city meeting Dec. 6 the taxpayers voted to indefinitely postpone the question of appropriating $25,000 for an electric light plant. The Rockville Gas Co. is improving its plant, and is preparing to furnish both arc and incandescent electric light. About 20 miles of wire have been received, and the dynamos are expected soon. We are informed by Wm. V. McNerney, Mayor, that a reorganized local company will probably furnish the city with light.

BATAVIA, N. Y.—At a special meeting of the Board of Aldermen Dec. 8 it was decided to advertise for proposals for electric street lighting. Bids will be received for a contract for two to five years for 73 arc lights of 2,000 c. p., the lights to burn till midnight or all night. The bids will be opened Dec. 28.

BROOKLYN, N. Y.—The Board of Aldermen has ordered the Citizens' Electric Light Co. to place 200 additional lights in such parts of the city as the committee shall decide.

FRANKLINVILLE, N. Y.—A meeting of the citizens was held Dec. 12 to appoint a committee to act with the Village Trustees in adopting an electric light system.

CINCINNATI, O.—The Cincinnati Electric Light Co. has decided to make extensive improvements in its plant. The station will be enlarged and improved, and another large station built. Several new features will be introduced, one of the newest being a novel arrangement for conveying and utilizing the "breeze" or waste coke from the adjoining cellars of the gas company for the purpose of generating steam.

SALEM, O.—The City Clerk will receive bids until Dec. 30 for lighting the streets by electricity for five years.

PROMPTON, ILL.—It is reported that a company is being formed for the purpose of furnishing the village with electric light.

COLUMBUS, KAN.—An electric light plant will be put in by a new company. H. R. Crowell is interested.

WESTPORT, MO.—The City Council is considering the issue of bonds for $100,000 for an electric light plant and a new city hall. It is thought that a desirable electric light plant can be put in for $50,000, and the citizens are reported in favor of the project.

NEW COMPANIES.—Brooklyn Electric Mfg. Co., Jersey City, N. J.; $20,000; S. O'Connor and W. S. Barstow, Brooklyn, N. Y., and M. Strong, Montclair. West End Electric Co., Pittsburg, Pa.; $50,000; Pres., F. B. Hershberger. Effingham Electric Light & Power Co., Effingham, Ill.; $15,000; Edward Austin, Calvin Austin, Dennis Bushor.

CONTRACT PRICES.

RESERVOIR.—Syracuse, N. Y.—The total bids for the construction of the distributing reservoir were published last week. The itemized bid of A. Van Wagner & Co., to whom the contract was awarded, at $255,355, is as follows:

Bailing and draining			$1,000.00
Rolling bottom and ramming sides of reservoir			1,000.00
Chopping grubbing and clearing within reservoir and under bank			1,500.00
Chopping and clearing outside reservoir	10 acres	at	50.00
Grubbing and clearing	400 sq. rods	"	1.00
Procuring, sowing and dragging in grass seed	600 "	"	.05
Excavating and depositing top soil	20,000 cu. yds.	"	.30
Soiling deposited in rear of embankment	8,000 "	"	.25
Earth excavation in trenches and foundations	18,000 "	"	.50
Earth excavation from bottom and sides of reservoir	175,000 "	"	.32
Rock excavation	200 "	"	2.00
Puddling earth and gravel	18,000 "	"	.30
Slope walls in cement mortar	9,500 "	"	4.00
Concrete masonry	18,000 "	"	4.50
Rubble masonry in cement	600 "	"	5.00
Rubble masonry in cement in backing	4 400 "	"	4 00
Cut stone coping in cement	90 "	"	20.00
Dimension cut stone in cement	150 "	"	25.00
Vitrified brick facing in walls	330 "	"	16.00
Pressed brick in gate house	50 "	"	15.00
Common brick masonry	220 "	"	12.00
Broken range face work	1,400 sq yds.	"	2.00
Cobble stone-pavement	1,600 "	"	.54
Painting	400 "	"	.50
Rough pointed face dressing	6,000 sq. ft.	"	.25
Chisel face dressing	2,000 "	"	.50
Trinidad asphalt floor	1.200 "	"	.20
Galvanized iron cornice on gatehouse	1,800 "	"	.18
Galvanized iron gutters and flashings	100 "	"	.08
Felt cement and gravel roof	1.500 "	"	.08
White oak timber and plank	5,000 ft. B. M.	"	100.00
" pine " "	12,000 " "	"	50.00
Hemlock " "	10,000 " "	"	25.00
Wrought iron	15,000 lbs.	"	.05
Cast iron	10,000 "	"	.04
Spikes and nails	600 "	"	.04
Wrought iron cable chain	500 "	"	.10
Cast iron specials	60 tons	"	60.00
Wrought iron I-beams	10 "	"	60.00
Pipe unloaded, hauled and distributed	540 "	"	1.25
Laying 36-in. pipe and specials	650 lin. ft.	"	.75
" 30-in. " "	720 " "	"	.70
" 18-in. " "	2'0 " "	"	50
" 8-in. " "	700 " "	"	.30
Galvanized iron beader	60 "	"	.15
Gas pipe hand rail	50 "	"	.10
Setting 36-in. valve gates and fixtures	7 gates	"	80.00
Setting 30-in. valve gates and fixtures	11 "	"	70.00
Setting 18-in. valve gates and fixtures	1 "	"	60.00
Setting 8-in. valve gates and fixtures	3 "	"	40.00
Double doors and transoms	4 doors	"	50.00
Windows and transoms over same	14 windows	"	30.00

PIER CONSTRUCTION.—Grand Rapids, Mich.—The following lowest bids for pier construction have been received by Maj. William Ludlow, U. S. Engr.: Edward G. Crosby, Muskegon; at St. Joseph harbor, (1), foundation piles, 4,488 lin. ft., 90 cts. per lin. ft.; (2), guard piles, 533 lin. ft., 40 cts.; (3), hemlock timber, 495,256 ft. B. M., $21 per M.; (4), pine timber, 230,800 ft. B. M., $26; oak timber, 1,302 ft. B. M., $50; (6), pine plank, 24,500 ft. B. M., $24; (7), S. & W. bolts, 7,565 lbs., 5 cts. per lb.; (8), drift bolts, 89,302 lbs., 3 cts.; (9), wrought spikes, 1,498 lbs., 5 cts.; (10), stone filling, 1,438 cords, $8 per cord; (11), dredging for foundations, 1,500 cu. yds., 50 cts. per cu. yd.; total, $36,697; at Muskegon harbor, (1), 6,904 lin. ft., 65 cts.; (2), 1,248 lin. ft., 35 cts.; (3), 780,282 ft. B. M., $17; (4), 331,080 ft. B. M., $24; (5), 2,400 ft. B. M., $40; (6), 35,000 ft. B. M., $20; (7), 17,446 lbs., 5 cts.; (8), 136,907 lbs., 3 cts.; (9), 2,140 lbs., 5 cts.; (10), 2,508 cords, $6.50; (11), 1,000 cu. yds., 50 cts.; total, $49,104. Wisconsin Dredge & Dock Co., Manitowoc, Wis.; at Michigan City harbor, (1), 3,040 lin. ft., 80 cts.; (2), 598 lin. ft., 30 cts.; (3), 312,192 ft. B. M., $18; (4),133,208 ft. B. M., $24; (5), 1,080 ft. B. M., $45; (6), 28,000 ft. B. M., $18; (7), 4,777 lbs., 4 cts.; (8), 54,923 lbs., 3 cts.; (9), 4,200 lbs., 4 cts.; (10), 1,324 cords, $8; (11), 300 cu. yds., 30 cts.; total, $24,669; at Grand Haven harbor, (1), 6,408 lin. ft. 70 cts.; (2), 1,274 lin. ft., 23 cts.; (3), 760,420 ft. B. M., $17.25; (4), 298,688 ft. B. M., $23.50; (5), 2,376 ft. B. M., $39; (6), 31,500 ft. B. M., $17.50; (7), 10,600 lbs., 3.95 cts.; (8), 150,826 lbs., 2.95 cts.; (9), 1,926 lbs., 4 cts.; (10), 2,520 cords, $7.15; (11), 300 cu. yds., 5 cts.; total, $47,947; at Manistee harbor, (1), 4,056 lin. ft., 58 cts.; (2), 598 lin. ft., 22 cts.; (3), 424,704 ft. B. M., $16.50; (4), 198,480 ft. B. M., $21.50; (5), 1,272 ft B. M., $39; (6), 21,000 ft. B. M., $15; (7), 6,619 lbs., 3.95 cts.; (8), 76,621 lbs., 2.9 cts.; (9), 1,284 lbs., 4 cts.; (10), 1,411 cords, $6.25; (11), 600 cu. yds., 20 cts.; total, $25,597.

EXCAVATING.—Boston Mass.—The following bids were received by the Park Commissioners Dec. 5, for excavating a drainage ditch at Franklin Field, the work requiring about 9,000 cu. yds. of earth excavation and 50 cu. yds. of stone: James Killian, 45½ cts. for the earth and $3 for the stone; H. P. Nawn, 58 cts., $2; Neil Devine, 64 cts., $1.48; Dennis O'Connell, 39 cts., $1; James McGovern, 38 cts., $1.50; Jones & Meehan, 32½ cts., $2; National Construction Co., 65 cts., $5; P. F. Lanigan, 29⅞ cts., $2.49; Rowe & Hall, 87 cts., $2.25.

DREDGING.—Cleveland, O.—The contract for dredging about 700,000 cu. yds. in straight channel through Maumee Bay for Toledo harbor has been awarded to G. H. Breymann & Bros., Toledo, at 12, 14 and 16 cts. per cu. yd. for the inner, turn out and outer section, respectively.

BRICK.—Seattle, Wash.—The contract for 35,000 brick for the ventilation shaft of the Lake Union sewer tunnel has been awarded to the Puget Sound Brick & Tile Co., at $7.75 per M.

MISCELLANEOUS.

DREDGING AND FILLING.—Oakland, Cal.—The Board of Public Works will receive bids until Dec. 20 for dredging that portion of Lake Merritt adjacent to the outlet into the Main Lake sewer, and for filling section 1 of the boulevard around Lake Merritt. This work was referred to under "Streets" last week.

HARBOR IMPROVEMENTS.—Newport, R. I.—Capt. W. H. Bixby, U. S. Engr., has prepared details of the work to be done during the coming summer. The amounts available are as follows: Newport harbor, $19,000; Nantucket, $18,000; Vineyard Haven, $5,000; Block Island, $18,000; New Bedford, $5,000; Hyannis, $3,600; Canapitsit canal, $3,100.

DREDGING, ETC.—Bids for the following work will be received by the U. S. Engineer Corps, at the dates specified: Dredging, Gowanus Bay, Dec. 21; Bagaduce River, Me., Dec. 22; ledge work, Kenebec River, Me., Dec. 22; Extending Piers, Fairport Harbor, O., Dec. 22; dike, Gray's Harbor, Wash., Dec. 24; breakwater, Dunkirk, N. Y., Dec. 30; removal of wreck, Egg Harbor inlet, N. Y., Jan. 5; stone work at Block Island, R. I., and Nantucket and Vineyard Haven, Mass., Jan. 9; dredging in Pawtucket and Providence Rivers, R. I., and Green Jacket Shoal, Providence Harbor, R. I., Jan. 9; in Canapitsit Channel, Vineyard Haven, Mass., Jan. 10; in Hyannis and New Bedford Harbors, Mass., Jan. 10; in Newport Harbor, R. I., Jan. 10;

DITCH.—Galion, O.—The Commissioners of Crawford and Huron Counties have been requested to construct a ditch through the New Haven marsh, 10 miles long, 30 ft. wide and 9 ft. deep. It would cost $18,000.

CONCRETE BOTTOM, ETC.—New York, N. Y.—The Department of Parks will receive bids until Dec. 21 for cleaning and constructing a concrete bottom in the Pond, in Central Park; for the erection of tool-house, sheds and skate house in Central Park; for boilers, water and drainage pipes for the aquarium in the Castle Garden building, in Battery Park; also for salt and fresh water filters for this aquarium. The first mentioned item includes 8,000 cu. yds. of excavation, 1,500 cu. yds. screened gravel and 3,400 cu. yds. concrete.

DITCH.—Norwalk, O.—The contracts for constructing the Noggie joint ditch will be sold at public auction by Engrs. Messard and Valentine Dec. 20. This ditch is intended to drain portions of Auburn, Richmond and New Haven townships, and is estimated to cost $16,128.

GAS LIGHTING.—New York, N. Y.—The Commissioner of Public Works will receive bids until Dec. 27 for lighting the public markets, buildings and offices by gas for one year from Jan. 1.

CITY HALL.—Milwaukee, Wis.—The contract for the new city hall was awarded Dec. 10 to A. Johnson & Bros., Chicago, Ill., at $721,000. In case the Common Council should decide to adopt the Ransom fireproof system, the total price will be $25,000 less than this.

GARBAGE CREMATORY.—Wilmington, Del.—The Board of Health has recommended that the city construct a garbage crematory.

GAS COMPANY.—Kalamazoo, Mich.—The Citizens' Gas & Fuel Co. has been organized with O. M. Allen, Sr., Pres.; J. W. Osborn, Vice-Pres.; Frank Henderson, Secy. The capital stock is $200,000. The new company will erect a large plant and a rate war with the old company is expected.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Rhode Island Locomotive Works, Providence, R. I., have completed the first of the double steam truck, double boiler, four cylinder compound engines for the Mexican Central (Eng. News, March 12 and 26, April 2 and 9, 1892). The Baldwin Locomotive Works, Philadelphia, Pa., have built a ten-wheel passenger engine for the Richmond & Danville, and six ten-wheel and six Forney suburban tank engines for the Chicago, Rock Island & Pacific; the tank engines have six driving wheels and six-wheel trucks. The Cooke Locomotive Works, Paterson, N. J., have an order for five six-wheel switching engines for the Chicago & Western Indiana. The Duluth & Iron Range will place orders for 20 heavy freight engines. The New York, Lake Erie & Western has added 20 consolidation freight engines, 12 switching engines and 5 passenger engines to its equipment within the last eight months. The St. Louis, Vandalia & Terre Haute is testing a compound locomotive. The Chautauqua Lake will add two engines to its equipment. The Pennsylvania is building 14 more heavy ten-wheel freight engines, with modifications suggested by experience with the first six, at its shops at Fort Wayne, Ind.

CARS.—The Ohio Falls Car Co., Jeffersonville, Ind., is building 200 box cars for the Florida Central & Peninsular, and 30 baggage cars for the New York Central. The Buffalo Car Co., Buffalo, N. Y., is building 200 gondola cars and 10 cabooses for the Buffalo, Rochester & Pittsburg, and 250 hopper gondola cars for the Delaware & Hudson. The Port Edwards, Centralia & Northern has added 15 flat cars to its equipment. The Standard Oil Co. is reported as intending to build car works at Whiting, Ind. The Canda Cattle Car Co., of New York, has been incorporated, with a capital of $800,000, for the manufacture of railway equipment, including car wheels, forgings, rolling stock, and other appurtenances of railways, but more especially for constructing cattle cars under patents controlled by Ferdinand E. Canda; the directors are: Charles S. Fairchilds and Valentine P. Snyder, of New York; Joseph Caven, of Philadelphia; J. Wilcox Brown, of Baltimore, and A. C. Loomis, of Hartford, Conn. Massillon, O., is trying to raise $35,000 to secure the location of the car shops for the Wheeling & Lake Erie. The Gulf Red Cedar Co., Pres., W. H. Parrish, Greenville, Miss., wants ten second-hand flat cars, standard gage, not less than 30 ft. long and 15 tons capacity.

STEAM ROLLER.—The Highway Department of Providence, R. I., has purchased a 15-ton Aveling & Porter compound steam road roller (Eng. News, July 14, 1892), from the builders' agent, W. C. Churchill, New York.

SHIPBUILDING.—The Cowles Engineering Co., of New York, has decided to establish a shipbuilding yard at Brooklyn, N. Y. The company already has works in operation for the manufacture of engines and the Cowles tubular boilers.

THE WALBURN-SWENSON MFG. CO., Chicago, Ill., is successor to the Fort Scott Foundry & Machine Works, of Fort Scott, Kan., and is erecting works at Chicago Heights, Ill., for the manufacture of machinery for coal washing, cane and beet sugar making, concentration of ore, and for chemical works and packing houses; also multiple effect evaporating apparatus, vacuum pans, diffusion batteries, filter presses, etc. General office, Monadnock Building, Chicago; branch office, 33 Broadway, New York. Pres., A. W. Walburn; Vice-Pres. and Secy., M. Swenson.

THE CALDWELL BOILER CO., 15 Cortlandt St., New York, has been awarded the contract for supplying 600-HP. boilers in the Metropolitan Realty Co.'s new 14-story building.

NEW COMPANIES.—Cook County Construction Co., Chicago, Ill.; $1,200,000; John H. Bradley, C. C. Bulkly and Henry E. Bartholomew. Mills Pneumatic Gate Co., Chicago, Ill.; $200,000; F. W. Mills and Edward Arnold. Weber Gas & Gasoline Engine Co., Kansas City, Mo.; $65,000; George J. Weber and D. C. McCarroll. Kirkwood Wind Engine Co., Arkansas City, Kan.; $50,000; Wm. M. Sleeth, J. P. Johnson and A. A. Newman. Maridotone Dockage & Improvement Co., Sag Harbor, N. Y.; $75,000; George C. Gibbs, R. J. Power and John Hildreth. Sperry Sewer Pipe Co., Akron, O.; $55,000; L. P. Sperry, David E. Hill, and C. P. Humphrey.

CURRENT PRICES.

RAILS.—New York: $30 at eastern mills, $30.75 at tidewater; girder rails, $36 to $39; old rails, $17 for iron, and $14.50 and $15 for steel. Pittsburg: $30; old rails, $20 to $20.50 for iron and $15.25 to $16 for steel. Chicago: $31 to $32.50; light rails, $32; old rails, $18.50 for iron, and $12.75 to $15 for steel.

TRACK MATERIAL.—New York: steel angle bars 1.6 to 1.65 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.4 to 2.6 cts. with square and 2.7 to 2.8 with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron and steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.75 to 1.8 cts. for iron and steel; spikes, 2.05 to 2.1 cts. at mill; track bolts, 2.65 to 2.75 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows at Pittsburg: 55% and 10%, and 47½% and 10% on black and galvanized butt welded; 65% and 10%, and 55% and 10%, on black and galvanized lap welded. Casing, 57½%.

FOUNDRY PIG IRON.—New York: $13.25 to $15. Pittsburg: $13 to $14. Chicago: $13.25 to $14.25.

LEAD.—New York: 3.75 cts.; Chicago: 3.72 to 3.75 cts.; St. Louis: 3.5 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.15 to 2.5 cts. for large lots, and 2.35 to 2.75 cts. for small lots; channels, 2.2 to 2.5 cts.; angles, 1.85 to 2 cts.; tees, 2.2 to 2.75 cts.; sheared iron plates, 1.85 to 2.1 cts.; steel plates, 1.85 to 2 cts. for tank, 2.2 to 2.25 cts. for shell, 2.5 to 2.65 cts. for flange, 2.7 to 2.8 cts. for firebox. Pittsburg: beams, 2 to 2.25 cts.; channels, 2 to 2.25 cts.; angles, 1.75 to 2 cts.; tees, 2 to 2.25 cts.; Z-bars, 2 cts.; universal mill plates, 1.75 to 1.85 cts. for steel; sheared steel bridge plates, 2.1 to 2.25 cts.; refined bars, 1.7 cts. for iron and steel; steel plates, 1.75 cts. for tank, and 2 to 2.25 for shell, 2.1 cts. for flange, 3.5 cts. for firebox, 2 to 2.1 cts. for bridge. Chicago: beams, 2.25 to 2.3 cts. for large lots, and 2.35 to 2.5 cts. for small lots; channels, 2.27 to 2.35 cts. for large lots, and 2.45 to 2.5 cts. for small lots; angles 1.9 to 2 cts.; tees, 2.2 to 2.3 cts.; universal plates, 2 to 2.1 cts.; steel plates (at mill), 2.5 to 2.1 cts. for tank, 2.12 to 2.25 cts. for shell, 2.25 to 2.4 cts. for flange, 2.7 to 2.8 cts. for firebox.